THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XII.—No. 276.

FLOUNDERING INTO FAILURE.

A very superficial acquaintance with the more than muttered opinions of the shareholding class in various electric light companies working special patents, must suffice to convince one that a large percentage of the limited liability undertakings is helplessly and hopelessly floundering towards liquidation, leaving alone those which have already been wound-up. But, while this broad fact is patent, it is not so easy for outsiders to discriminate between the various reasons which are adduced as accounting for this result. These reasons are various, according to the standpoint from which a judgment is formed. The directors of more than one company—and none of them are in a more flourishing financial condition than they or we could desire—attribute the absence of profits, and therefore of dividends, to the detrimental effect of the recent Electric Lighting Act, as having destroyed hope which may not unnaturally have been entertained of profitable arrangements being made with Vestries and other Local Authorities, or even individuals, for distributed electricity—the necessity for Provisional Orders or licences standing in the way to some extent of that old-fashioned freedom of contract which would have been taken advantage of had the Act of 1882 not been passed.

But in how far the result would, as regards the financial prospects of companies, have been different had the Board of Trade never troubled itself with the subject at all, may be a matter of speculation and opinion. Certain it is, however, that the restraint of this Act will, at many a meeting of shareholders, be put forward as responsible for much of the absence of balance from that side of the accounts which shareholders have a very natural preference for. This view is that taken by many directors of companies, particularly of the less successful, but whatever amount of truth or exaggeration there may be in it, it is not the view taken by the general body of shareholders themselves, whose weakness consists rather in ascribing—perhaps sometimes too readily—the non-success of any company to the incompetence of their directors and not to any inherent weakness in the system upon which the company started business, or to the fault of over-estimation of prospects at starting. As a rule, it may be safely affirmed that directors were not originally responsible for the extravagant hopes held out in the prospectus. These tempting documents were, as such tempting documents generally are, drafted by, or at the instigation of, promoters; and the great majority of directors, like the great majority of shareholders, have been entrapped by them for good or ill, as the case may be. When a company is apparently successful, while business goes merrily and the board has the prospect of dividends to lay before the shareholders, all goes happily, and everybody is pleased with everybody else. But the reverse of this picture comes in when these men sit round the table and feel that the company they direct is not successful, that what business there is merely lessens the current losses, if even that, and that, when they meet their shareholders, as meet them they must, there will be but a sorry tale to tell, and possible reproaches to listen to—of hopes unjustifiably raised—perhaps charges of crass ignorance of the business they have undertaken to conduct. This is the skeleton which, stowed away in more than one board-room cupboard, disheartens and discourages directors who begin to feel themselves in the wrong place in a business they know technically little or nothing about. And the result is bad feelings and bad tempers at the board-room table, which greatly disorganise the working parts and prevent things being looked at so straight in the face as would be desirable in the interests of the undertaking.

But are directors only to blame in the matter? If shareholders blindly rush in to invest their capital in undertakings of a purely speculative character in the development of processes which are essentially experimental, can they reasonably blame anybody but themselves for their folly? Would it not obviously be a man's duty to himself before he invest his hundreds or thousands to refer to some expert to guide or advise him? The common precaution which a man takes before investing his money in a house or in land he entirely omits if the money is to be invested in some visionary undertaking. If he puts his money in a house he calls in a valuer, lawyer, and counsel to advise on value and title; if he puts his money in shares which he applies for, in nine cases out of ten he consults nobody. In fact, it becomes a risk, and he runs it bravely enough until the odds fall out against him, and then he is ready to blame anybody he can, except himself, particularly the directors. Directors cannot create something out of nothing, they cannot create a profitable supply when there is practically no demand, and in this respect the greater part of the talk we hear of incapacity of this or that board of directors is very often silly. But in many instances they are to blame in other ways. The average director of a new electric light company is entirely ignorant of the business—if electric lighting could or can be called a business in the usual sense of the word, even now—and while from this cause, at least, when he first joined, his services were intrinsically of little or no value to the shareholders, fees of two or three hundred a year tempted him to undertake the position which he was not qualified for, and, being there, self interest leads him to draw his fees while the company he helps to manage in a blundering sort of way, is going financially from bad to worse. Of course there are exceptions to this picture of the average director, but unhappily not many, and when such an exception is found his voice is too frequently silenced by a duller majority of his fellow-directors. Directors, if they cannot always be useful, can generally be obstructive, and seldom fulfil their most desirable function of being silent. The reason why boards of directors are so badly chosen, is that promoters who invite them consider, not whether the men are capable men, but if their names will draw capital. Herein lies the secret of many a bad working board.

It certainly cannot be affirmed that the class from which directors are enlisted is a limited one; we have seen every grade of the social scale liberally represented—from the noble lord to the ex-butler—from, in fact, the noble Don to Dogberry and Verges on the same board. The difficulty does not come from class selection, but from a general and

unavoidable ignorance of a business which, being new, no opportunity can have been afforded to the director class, wide as it is, to acquire experience in.

There is, however, a fault in the management of some electric light businesses, viz., the tendency to ignore the experience and advice of the inventor as soon as his invention is handed over, and to do without aid which should, in the absence of able experts in the regular employ of the company, be considered indispensable. Inventors do not always work out thoroughly all the capabilities of their inventions before they part with them. Of course they are complete up to a certain point, at which they can be shown in action; but anything approaching exhaustive and critical trials are often left to the company to undertake, and this when the inventor's pecuniary interest is satisfied, and the board relieved of any guidance or tutelage which might upon occasion wound their vanity.

To have any reasonable hope of ultimate success, it should be the never-ceasing effort and object of those responsible for the administration of an electric light company to keep a careful watch upon the behaviour of every detail of the system used—dynamos, lamps, wires, &c.—and to improve, as it is discovered, whatever is susceptible of improvement. There can be no profitable conservatism in electric lighting at its present stage, and it may be safely asserted that the date upon which a board of directors make up their minds that the special system of their company is perfect and no longer needs a jealous watchfulness, is the date from which the retrogression of the company's business may, with tolerable certainty, be looked for.

It may be through ignorance on the part of directors or through difficulty in procuring competent expert aid; but certain it is that the technical aid at the service of a great majority of the electric light companies is of a very second-rate order. Some companies, of course, have able engineers; but a great many are satisfied with a foreman or some half-educated man of that class, who becomes their engineering guide, and who, in instances, instead of taking broad views and striving to perfect the invention, as the inventor or other competent engineer would do, is staunchly conservative to the limit of his capacity, and to the regularity with which he draws his pay. We know some excellent foremen and handy men in the employ of several companies; but generally speaking they would be more excellent and more handy if the mental guidance of the inventor or some equally qualified expert were constantly available to instruct them. To the want of a better selection of expert help, or neglect to secure when possible the continued and active co-operation of the inventor himself, may be ascribed much of the backwardation of some of the companies. If in some companies a slight reduction of the number or emoluments of the directors could be arranged, and a portion of the saving expended in more competent technical management, a considerable improvement might even now be achieved.

The selection of general staff too is not unobjectionable: managing directors and others have not always resisted the temptation to find places for relatives and friends, or to provide a "shunt" for some *employé*, the cost of whose services they may have desired, on friendly terms, to be rid of, regardless of the fitness of the persons themselves for the new duties required of them.

When some of the companies started they were, no doubt, badly off for plant, and the want of a sufficient stock of appliances was a valid reason why a limited amount of business or none could be undertaken then. This was a reason which the board of more than one company assigned to inquiring shareholders why the foreshadowed profit did not appear to be coming in; but any form of requisite plant could be procured from a capable firm of contractors in a month, and almost any reasonable number of dynamos and lamps in two months after receipt of order. This excuse, therefore, which may have been reasonable enough in the first few weeks after starting, becomes something more than ridiculous as months go on and it is still repeated. Where there is any ground for such an excuse six months after a company has commenced operations, it would furnish a proper subject for investigation.

The fact is, the whole secret lies in a nutshell, and the sooner it is known and acknowledged the better. The demand for electric lighting falls lamentably short of its possible supply; and as the majority of the companies were formed with a view to provide the possible supply rather than in proportion or response to any actual or probable demand, and some few with only the object of granting concessions, the majority of the companies, unless some good fairy steps in and with the touch of a magic wand enchants the public with a sudden desire to throw away their gas-fittings and pay for the luxury of electric lighting, must, after a further struggle in vain, subside into liquidation.

The outlook is sad for *bonâ fide* investors, and electric lighting may perhaps be retarded in consequence to some extent. But it is of no avail to shut our eyes to facts as they exist. If all the present electric lighting were in the hands of a single company it would be paying a good dividend. If in the hands of two it might still be sufficient; but distributed amongst twenty or thirty, they must either all starve or some, the weakest, of course, must go altogether to the wall, and the winners in the struggle will probably not be the electric lighting companies working special patents at all but the manufacturers of electric lighting apparatus, whose capital is invested in actual tools and workshops, and not in, as is so often the case, visionary patent rights. Into the hands of the manufacturers we may probably expect to see the legitimate business eventually gravitate, to the extinction, more or less complete, of the special patent-holding companies.

Mr. Edison's Electric Railway.—Mr. Edison is said to have replied to inquiries regarding his electric railway as follows:—"I have it running a distance of two and a half miles. The locomotive runs at the rate of twenty-nine miles an hour, with one passenger car capable of holding 40 passengers. It is a three feet six inches gauge, with a 16-pound rail. The weight of the locomotive is three tons, sufficient for light trains, and runs often. I put it up as an experiment. I have also a freight train, which carries 30 tons of freight and makes eight miles an hour. I have only eight horse-power on the locomotive. I am now, however, building a large one of 45 horse-power, with which I expect to be able to pull about 18 coal cars. The track of my road has been down some months, and still holds its insulation. I made a run the other day at the rate of twelve miles an hour in the snow, and there was only a leakage of two and a half horse-power on the whole line of the road."

OHM'S LAW.

SINCE electric lighting has come so prominently to the fore no electrical law has been more frequently used than that which expresses the relation between the current, the resistance, and the electromotive force (or difference of potential) between two points in a circuit. By means of this relation we are enabled to determine the resistance, r, of a circuit, the current, c, flowing, and the electromotive force, e, between the electrodes, being known, for we have the relation—

$$c = \frac{e}{r},$$

from which either c, e, or r can be determined, the two other quantities being given.

Now, Ohm's law is generally explained as follows: If we have a closed circuit in which there is a battery of an electromotive force, E (*i.e.*, the difference of potential between the battery poles when the latter are disconnected), then if R be the total resistance in the circuit, the current, C, flowing will be—

$$C = \frac{E}{R}.$$

Although the law first referred to is really a natural consequence of that just stated—in fact, is the same law—yet it is by no means apparent why it should be so; the following proof may therefore prove interesting.

In fig. 1 let E be a battery of electromotive force, E, and

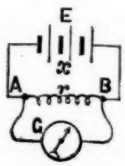


FIG. 1.

FIG. 2.

resistance, x, joined up in circuit with a resistance, r, and let G be a galvanometer of a resistance infinitely greater than the other resistances, so that it does not affect the flow of the current in the circuit, $x + r$. Now, the current, C_1, flowing through the galvanometer will be—

$$C_1 = \frac{E}{x + \frac{r\,G}{r+G}} \times \frac{r}{r+G} = \frac{E\,r}{x\,r + x\,G + r\,G}$$

It is evident that the current flowing through the galvanometer must be due to the existence of an electromotive force in some portion of the circuit in which it is placed; and it is, moreover, evident that this electromotive force must exist between the points A and B, in the portion of the circuit external to G. Let e be this electromotive force (fig. 2), then we have—

$$C_1 = \frac{e}{G},$$

but

$$C_1 = \frac{E\,r}{x\,r + x\,G + r\,G},$$

therefore

$$\frac{e}{G} = \frac{E\,r}{x\,r + x\,G + r\,G},$$

that is,

$$\frac{e}{r} = \frac{E\,G}{x\,r + x\,G + r\,G} = \frac{E}{\frac{x\,r}{G} + x + r}$$

or, since G is infinitely great,

$$\frac{x\,r}{G}$$

is equal to 0; hence

$$\frac{e}{r} = \frac{E}{x + r}.$$

But by Ohm's well-known law, the current, C, flowing out of the battery—that is, flowing through r—is

$$C = \frac{E}{x + r},$$

therefore,

$$C = \frac{e}{r},$$

that is, the current flowing through r between the points, A B, is equal to the electromotive force (or difference of potential) between the points, A B, divided by the resistance, r, between them. It may, perhaps, be as well to point out that the law is only true when there is no electromotive force in the resistance, r; the electromotive force must, in fact, be external to r.

H. R. K.

THE AMERICAN BELL TELEPHONE COMPANY v. AMOS E. DOLBEAR ET AL.

WE are indebted for the information concerning this suit to an American correspondent. The case was heard before Justices Gray and Lowell, and the opinion of the Court is as follows:—

It was decided by this court in *American Bell Telephone Company* v. *Spencer*, 8 Fed. Rep. 509, and is not denied by the present defendant, that Bell is the first inventor of a speaking telephone. The only controversy is of the extent of his patent. . . . The patent is clearly not intended to be limited to a form of apparatus, but embraces a method or process. This is apparent upon the face of the specification.

The inventor begins by saying, "My present invention consists in the employment of a vibratory or undulatory current of electricity in contradistinction to a merely intermittent or pulsatory current, and of a method of and apparatus for producing electrical undulations upon the line wire."

After describing the advantages of an undulatory current, resulting from gradual changes of intensity, over a pulsatory current caused by sudden changes of intensity, he says: "It has long been known that when a permanent magnet is caused to approach the pole of an electro-magnet, a current of electricity is induced in the coils of the latter, and that, when it is made to recede, a current of opposite polarity to the first appears upon the wire. When, therefore, a permanent magnet is caused to vibrate in front of the pole of an electro-magnet, an undulatory current of electricity is induced in the coils of the electro-magnet, the undulations of which correspond, in rapidity of succession, to the vibrations of the magnet, in polarity to the direction of its motion, and in intensity to the amplitude of its vibration;" or, as he afterwards repeats in fuller language: "Electrical undulations, induced by the vibration of a body capable of inductive action, can be represented graphically, without error, by the same sinusoidal curve which expresses the vibration of the inducing body itself, and the effect of its vibration upon the air; or, as above stated, the rate of oscillation in the electrical current corresponds to the rate of vibration of the inducing body, that is, to the pitch of sound produced; the intensity of the current varies with the amplitude of the vibration, that is, with the loudness of the sound; and the polarity of the current corresponds to the direction of the vibrating body, that is, to the condensations and rarefactions of air produced by the vibration."

He further says: "There are many ways of producing undulatory currents of electricity, dependent for effect upon the vibrations or motions of bodies capable of inductive action. A few of the methods that may be employed I shall here specify. When a wire, through which a continuous current of electricity is passing, is caused to vibrate in the neighbourhood of another wire, an undulatory current of electricity is induced in the latter. When a cylinder, upon which are arranged bar magnets, is made to rotate in front of the pole of an electro-magnet, an undulatory current of electricity is induced in the coils of the electro-magnet.

"Undulations are caused in a continuous voltaic current by the vibration or motion of bodies capable of inductive action, or by the vibration of the conducting wire itself in the neighbourhood of such bodies. Electrical undulations may also be caused by alternately increasing and diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery. The internal resistance of a battery is diminished by bringing the voltaic elements nearer together, and increased by placing them farther apart. The reciprocal vibration of the elements of a battery, therefore, occasions an undulatory action in the voltaic current. The external resistance may also be varied. For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting wire is immersed in the mercury or other liquid, the less resistance does the liquid offer to the passage of the current. Hence the vibration of the conducting wire in mercury or other liquid included in the circuit occasions undulations in the current. The vertical vibration of the elements of a battery in the liquid in which they are immersed produces an undulatory action in the current by alternately increasing and diminishing the power of the battery. . . . .

The inventor adds this explanation: "In this specification the three words 'oscillation,' 'vibration,' and 'undulation' are used synonymously, and in contradistinction to the terms 'intermittent' and 'pulsatory.' By the term 'body capable of inductive action,' I mean a body which, when in motion, produces dynamical electricity. I include in the category of bodies capable of inductive action, brass, copper, and other metals, as well as iron and steel."

His fifth and final claim is of "the method of and apparatus for transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the

vibrations of the air accompanying the said vocal or other sounds, substantially as set forth."

In this claim, as throughout the specification, the word "method" is evidently used, not as synonymous with "mode" or "apparatus," but as equivalent to "process;" just as it was used by Chief Justice Taney, delivering the judgment of the majority of the court, in *Morse* v. *O'Reilly*, 15 How. 62, 117, as well as by Mr. Justice Grier (who dissented in *Morse* v. *O'Reilly*) in delivering the unanimous judgment in *Corning* v. *Burden*, 15 How. 252, 267. And the invention claimed is not merely the apparatus described, but also the general process or method, by which the wind, or a musical instrument, or the human voice, produces in a current of electricity a succession of electrical disturbances, not sudden and intermittent or pulsatory, but gradual, oscillatory, vibratory, or undulatory, so as to give out at the farther end of the conducting wire sounds exactly corresponding in loudness, in pitch, and in tone, character or quality, to the sounds committed to it at the nearer end.

The opinion in *Spencer's case* clearly points out that "Bell discovered a new art—that of transmitting speech by electricity—and has a right to hold the broadest claim for it which can be permitted in any case," and "the invention is nothing less than the transfer to a wire of electrical vibrations like those which a sound has produced in the air;" and that his patent, while not covering the abstract principle, without regard to means, of transmitting speech by electricity, yet is not limited to a particular form of apparatus, but includes the process or method (using the two words as equivalent), the essential elements of which are "the production of what the patent calls undulatory vibrations of electricity to correspond with those of the air, and transmitting them to a receiving instrument capable of echoing them."

The evidence in this case clearly shows that Bell discovered that articulate sounds could be transmitted by undulatory vibrations of electricity, and invented the art or process of transmitting such sounds by means of such vibrations. If that art or process is (as the witnesses called by the defendants say it is) the only way by which speech can be transmitted by electricity, that fact does not lessen the merit of his invention, or the protection which the law will give to it.

The mode or apparatus by which Bell effects his purpose is, by using an electro-magnet in the transmitter, and another electro-magnet in the receiver. But the essence of his invention consists, not merely in the form of apparatus which he uses, but in the general process or method of which that apparatus is the embodiment.

Dolbear likewise uses an electro-magnet in the transmitter; and both his method and his apparatus, as is admitted in his own affidavit, are substantially like Bell's, until he comes to the receiver. For the magneto-receiver, Dolbear substitutes a condenser-receiver, consisting of two thin metal diaphragms or discs, of about the size and thickness of those used in an ordinary Bell telephone, separated by a very thin air space, one or both discs connected with the conducting wire, and the speaking disc, if not so connected, otherwise charged with electricity; so that, as the varying currents flow into and out of this condenser, the two discs attract one another more or less strongly, and thereby vibrations are set up which correspond to the vibrations of the original sound.

The main difference on which the defendants rely is, that Bell uses what is called dynamic electricity, producing by its motion an electric current; while Dolbear, in his receiver, uses what is called static electricity, producing, while at rest, electrical attraction. And the learned counsel for the defendants illustrate the distinction thus: "It was known, long before Bell's method, that electricity had two properties, very much as water has two properties, namely, first, pressure or head, or that property which tends to make it flow, and which can exist by itself only in the case of an insulated and charged body, or a reservoir of water; and, secondly, that dynamic property arising from its motion, and which never can exist by itself, but depends upon the quantity in motion and the rate of motion. This is not an absolutely exact way of expressing it, for the reason that electricity is not a fluid; but, were it a fluid, the statement would be entirely exact."

It does not appear to us to be important to determine whether, in scientific exactness, the varying influences of static electricity may properly be called currents; or whether the two properties of electricity differ in kind and in substance, or only in degree, or in the form of manifestation and application; or whether the force of the property which tends to make a fluid, when stationary, change its place and flow, is different in kind from that which it exerts, when changing its place and flowing—in short, whether the power of the pressure of water in a reservoir is different in kind from water-power in a stream or current.

Whatever name be given to the property, or the manifestation, of the electricity in the defendants' receiver, the facts remain that they avail themselves of Bell's discovery that undulatory vibrations of electricity can intelligibly and accurately transmit articulate speech, as well as of the process which Bell invented, and by which he reduced his discovery to practical use; that they also copy the mode and apparatus by which he creates and transmits the undulatory electrical vibrations, corresponding to those of the air; and that in the plate charged with electricity, which they have substituted for the magnetic coil in the receiver, the charge constantly varies in accordance with the principle which Bell discovered, and by means of the undulatory current caused by the process and in the mode which he invented and patented.

The defendants have therefore infringed Bell's patent by using his general process or method, and should be restrained by injunction from continuing to do so; and it is unnecessary, for the purposes of this decision, to consider whether the defendants' apparatus is a substantial equivalent of the plaintiff's, or whether it is an improvement for which Dolbear might himself be entitled to a patent.

Temporary injunction ordered.

THE ELECTRIC LIGHTING ACT.

(PROVISIONAL ORDERS.)

THE Board of Trade has issued draft clauses, which are submitted for consideration as rough drafts of model clauses to be inserted in Provisional Orders. They are prefaced by a memorandum, which explains that they do not, of course, constitute a complete Order; clauses applicable only in particular cases, clauses with regard to the breaking up of private streets, railways, tramways, &c., general clauses as to notices, &c., saving clauses, and others are omitted; but they are intended to include the main subjects of general interest as to which any controversy is likely to arise. The following points are those which are noted as requiring special attention:—

1. *The Choice of the Area of Supply.*

The clauses with regard to this are framed on the supposition that a fair area should be included in Schedule A, in which the undertakers may make an experiment, and to which, if they find that experiment not sufficiently remunerative to induce them to extend their operations, they may be allowed to confine themselves. At the same time it is proposed that a further area should be included in Schedule B, to which the undertakers may, after feeling their way by their first experiment, extend their operations by degrees, subject to the right of the local authority, or where the local authorities are themselves the undertakers, of certain inhabitants, at any time to require the undertakers to forthwith extend their operations over any part of such area or to resign their rights over such part. It is, therefore, suggested that local authorities in whose districts companies are seeking powers would do well to take care that the area proposed to be included in Schedules A and B respectively, are such as may fairly be included therein, having regard to the future development of the supply of electricity within the district. If, owing to local circumstances, as, for instance, in the case of small towns, they deem it necessary to allow the undertakers to include in Schedule A all the most remunerative parts of the district, it will be for them to consider whether they should not propose clauses for withdrawing some part of the area included in Schedule A from the area of supply if the undertakers decline to extend their operations beyond it in order to encourage other undertakers to come in and supply a larger area.

2. *The Question of Capital.*

The clauses on this subject are only applicable in the case of companies. In such a case it is proposed that the undertakers should be required within six months to set aside and appropriate as a separate capital, for the pupose of the particular undertaking, such a sum as would appear reasonably sufficient to enable them to meet all probable demand for a supply in the area included in Schedule A; and, in addition to this, and as a part of such separate capital, to deposit or secure to the satisfaction of the Board of Trade within the same period a sum not less than one-half the amount, which may be reasonably calculated as the capital necessary to enable them to execute the works which they are required to execute within two years in certain specified streets in Schedule A, and to supply electricity therein. Similarly, in the case of Schedule B, additional sums are from time to time to be added to the separate capital of the undertaking, and fresh sums to be deposited or secured in respect thereof as separate parts of the area included in Schedule B are added to the area of supply, to such amounts respectively as the Board of Trade upon directing such additions to be made may prescribe.

3. *As to the Modes of Supply.*

The parallel system is the system of supply adopted as the standard system in these clauses, and it is not proposed at first to give a right either to the local authority or to private consumers to demand a supply for public or private lighting on any other system; the provision is made that, with the approval of the Board of Trade, any other system may be substituted. Of course, by agreement, any system whatever may be employed, provided that it complies with the regulations as to safety and otherwise, special provision being made in the clauses that if it is desired to supply at high tension for arc lighting or other purposes this may done under special regulations.

4. *As to Time of Supply.*

It is proposed that this should be continuous, subject to six months' grace upon first commencing supply, when the undertakers need only supply between sunset and sunrise, and to a power on the part of the Board of Trade to permit special intermissions for the purposes of testing or otherwise. It may, however, be well for local authorities to consider in every case how far continuous supply is desirable for their district; as, however necessary it may be thought in crowded cities, where artificial light may probably be in constant demand, where there is only a slight demand in the daytime, as in country towns, the small additional convenience may not improbably be more than counterbalanced by the much higher price which must almost of necessity be charged for electricity where there is a continuous instead of an intermittent supply.

5. *As to Price.*

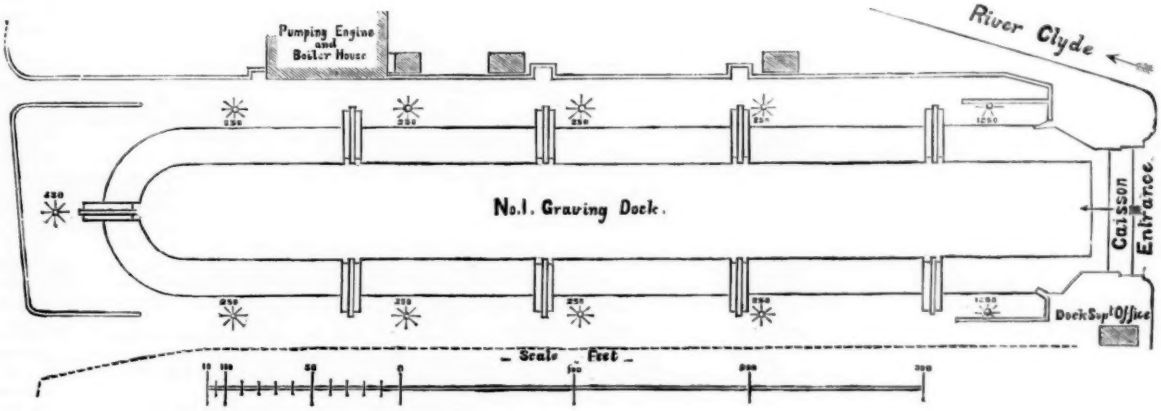
It is proposed that electricity should in all cases be charged for by meter; but as at present it seems doubtful whether there is any reliable meter for quantity or energy, a power is given to the undertakers to charge for the present, and until the Board of Trade otherwise direct, by the maximum current required and the number of hours during which electricity is used. The latter, however, does not seem a very satisfactory mode of charging, and it is hoped it may soon be dispensed with, as there seems to be no doubt that meters for quantity and energy will soon be perfected for practical use.

6. *As to Limitation of Profits, Revision of Prices, Monopoly, &c.*

No clauses are inserted dealing with the above subjects. In the case of companies the undertaking can be purchased by the local authority at farthest at the end of 21 years at the then value of the plant. In the meantime there is, in the first place, the competition with gas, which is likely to be very severe; and, in the second place, the potential competition with other undertakers to keep down prices, as the Board of Trade see no reason whatever why such last-mentioned competition should not be an active and potent force. The accounts of the undertakers are open to all. No monopoly is, under the Act or the Provisional Order, granted or intended to be granted to them; and should they neglect their duties in the district or charge exorbitant prices, there is nothing to prevent the immediate grant of a licence or Provisional Order to a competing set of undertakers within the same district. In the case of local authorities there will be not only competition to look to but also public opinion, and the Board of Trade prefer to rely upon the above considerations rather than to attempt to impose artificial restrictions, which in other cases have not proved too successful.

BRAY'S SYSTEM OF GAS-LIGHTING.

THE accompanying illustration is a sketch of the graving dock at Govan. It is illuminated by means of gas, the trustees of the Clyde Navigation having adopted Bray's system. There are two lanterns of 1,250 candle-power each = 2,500 candle-power. Each one consumes 209 cubic feet of gas per hour = 418 cubic feet per hour for the two. One lantern of 550 candle-power, using 100 cubic feet of gas per hour, and eight lamps of 250 candle-power each, individually consuming 45 cubic feet of gas per hour, or a total of 360 cubic feet per hour. The total candle-power is 5,050, and the total consumption of gas per hour 878 cubic feet, costing 3s. 3d.



When the full lighting power of the lanterns is not required, it can be reduced by means of a double service arrangement on the lanterns, enabling each of them to be reduced to single burners, the total consumption will then be about 77 feet for all per hour, at a cost of only 3¼d.

Reference was made to Bray's system of gas-lighting by Mr. Andrew Jamieson, C.E., in his lecture, which we published in full in the ELECTRICAL REVIEW for February 24th and last week.

Death of an American Statesman and Electrician.—The Hon. Marshall Jewell, the eminent American statesman, who died on the 10th ult., at Hartford, Connecticut, and who was born at Winchester, New Hampshire, on the 20th of October, 1825, was the son of a tanner, and after learning his father's business he studied electricity in Boston, particularly in relation to the then new art of telegraphy. At the age of 23 he superintended the construction of telegraph lines between Louisville and New Orleans. In 1849 he became general superintendent of the New York and Boston telegraph line; but on the death of his father he became the head of the firm of Jewell and Co., which had already taken rank among the great business establishments of the State.

ON THE CHARACTERS OF THE INDUCED CURRENTS RESULTING FROM THE RECIPROCAL MOVEMENTS OF TWO MAGNETIC BODIES PARALLEL TO THEIR AXES.

M. Th. Du MONCEL.

IF we move longitudinally before a straight electro-magnet, whose helix is connected with a galvanometer, one of the poles of a permanent magnet, we develop successively three induced currents; the first, which results from the approach of the inducing pole and which corresponds to an inverse or magnetisation current; the second, which results from the movement effected by the inductor from one end to the other of the electro-magnet, and which has a direction contrary to the first; and the third, which, although in the same direction as the first, is direct, or corresponding to a demagnetising action. This last current is in the same direction as the former, because the action, being effected in both cases at different ends of the electro-magnet, the effects which should be inverse are compensated. If, however, we cause the inducing pole to make a great movement comprehending the sum of the three movements just mentioned, the galvanometer indicates merely a single current corresponding in direction with that produced by the inducing pole moving from one end of the core to the other. It is the strongest because it results from a reaction effected nearest the magnetic core of the electro-magnet, and because it is developed with the same intensity during the whole course of the electro-magnet. This current belongs to the class which I call currents of polar inversion.

If we polarise the iron core of the straight electro-magnet of the former experiments by putting it in contact with one of the poles of an electro-magnet or of a powerful magnet, and repeat the above experiment, we find that this polarisation exerts no influence upon the direction of the induced currents developed. Their intensity alone varies, being smallest when the poles opposed to each other in the movement of the inductor are of the same name, and greatest when they are of contrary names. The nature alone of the inducing pole or the direction of the coils of the helix of the induced electro-magnet has an action upon the direction of the currents. These effects are due to an action of polarity of the inductor; for if we substitute for the inducing magnet a piece of soft iron, we find that the currents produced on repeating the above experiments vary in direction according to the polarities of the core of the electro-magnet.

Hence it results that the polarisation of an iron core renders a certain quantity of magnetism immovable. It remains, consequently, indifferent to the dynamic excitations provoked by exterior magnetic reactions, and is only influenced when, being able to react upon the inductor itself, which super-excites its energy, it polarises it in turn, so that the action and reaction are effected in a concordant direction. What is curious is that a very feeble magnet may determine the actions which we have explained in the first place—actions which, as it is seen, are very different from those excited by soft iron.

A consequence which may be derived from this kind of effects is that the induced currents due to the approach of the inductor to the polarised core are in the same direction as the current which has provoked the magnetisation of the latter when the poles opposed to each other at the moment of approximation are of the same name, which is the inverse of the ordinary cases of magneto-electric induction. This circumstance may perhaps explain why, in the electro-motor of M. Griscom, the motor is benefited by induced currents there developed.

I wished to be satisfied that the above effects were the same with a closed as with an open electro-magnetic system. To this end I polarised the straight electro-magnet, sometimes at a single pole, and sometimes at both poles at once. In the latter case I introduced my straight electro-magnet between the poles of a horse-shoe electro-magnet arranged for the purpose. The system was then closed, and when the electro-magnet touched with one of its extremities only one of the poles of the horse-shoe electro-magnet, the system was open.

On repeating the experiments described above, I found that the effects were always the same as to the direction of the induced currents occasioned, but differed very much in their relative intensities. The currents due to the approximation of the inductor, which, with the opposite poles opposed to each other and with the magnetic system open, are more energetic than when these poles are of the same name, become, on the contrary, less energetic with the magnetic system closed; an analogous effect is manifested if we act on a non-polarised system. The currents due to the approximation are then with the open system almost double those of the closed system. It is readily intelligible, that with the system open the magnetisation by influence is only effected upon the core covered with the helix, whilst with the closed system it is divided between the two.

When instead of reacting upon the complete electro-magnetic system, *i.e.*, provided with its iron core, we cause the inducing pole to act only upon the helix of the straight electro-magnet, the effects recur which we have described in the first place, but the induced currents produced give rise only to galvanometric deviations scarcely appreciable, 2°-3°, and the current resulting from the three movements combined is almost nil, which shows that the action of the magnet upon the wire is infinitely less than the action of the magnet upon the magnetic system which occupies the centre of the helix.—*Comptes Rendus.*

LECTURES ON ELECTRICAL SCIENCE.

THE second of the series of six lectures on the applications of electricity was delivered on Thursday evening, the 1st of March, by Sir Frederick Bramwell, F.R.S., V.P. Inst. C.E., the subject being "Telephones." The following is an abstract of the lecture:—

Prior to the invention of the telephone, by making and breaking contact at the transmitting station sounds had been produced at the receiving station—such as the striking of bells, or the vibration of a Morse sounder—but these were independent of sound at the transmitting station, and they varied according to the implement used at the receiving station, and were and are used for purposes of audible telegraphy. Also, prior to the invention of the telephone, it was possible to reproduce at the receiving station, say by a tuning-fork, the vibrations of which break and make contact, the same note produced by a similar tuning-fork at the transmitting station; and in this case there was a reproduction at the receiving station of the sound at the transmitting station. But the only thing that was insured was the repetition of the same note—there was no reproduction of the same sound. For example, the note might have been uttered by a violin-string, by a tuning-fork, or by a clarionet at the transmitting station; at the receiving station, however, nothing would be given forth but the note of the particular tuning-fork, or other vibrating implement, which was in accord with the number of the vibrations transmitted in a given time. All these modes were due to the variations of the current caused by break and make in the circuit, and were therefore abrupt. The best result obtained with such an agency was in the machine of Reis, who, in 1862, reproduced tones, and it is said some words were heard. That machine received no development, and telephony lay dormant for fourteen years, until the invention of Prof. Graham Bell, patented in this country in December, 1876. In 1874 Mr. William Henry Barlow, F.R.S., Past-President Inst. C.E., turned his attention to the recording of the vibrations produced by speech. He effected this by means of an instrument called a logograph. This was communicated to the Royal Society, and exhibited in operation there. By its agency there was depicted on a travelling band of paper the motions derived from the vibrations of a membrane under the influence of speech; but had the results been known they would probably have deterred an inventor seeking to produce a telephone, as it appeared the vibrations were not always the same for the same syllable, but varied with the speaker and from the circumstances. Prof. Graham Bell graphically represented the variations in the electric current, either direct or reversed, caused by break and make, and showed that these were too abrupt for his purpose—namely, the reproduction of articulate speech. He proposed to attain the object sought by having the circuit always closed, and by causing rises and falls, or reversals, as the case might be, of electricity which should be made gradually, instead of abruptly, as before. The simplest mode in which he attained this end was in one of the original forms of the Bell transmitter or receiver (for the instrument was capable of fulfilling either function) by placing an iron or a steel plate in the neighbourhood of a permanent magnet surrounded by a coil of insulated wire, so that on the plate being set into vibration by the voice it should induce, in the coil, reversed currents of electricity which could travel along the wire in prolongation of the coil to the coil of the similar instrument at the receiving station, thereby varying the power of the magnet at that station and setting up vibrations in the corresponding iron disc. This disc, acting upon the air, gave to it vibrations similar to those which had put the first disc into motion, and, in that way, a reproduction of the original sound (as Prof. Bell said a *fac simile*) was obtained. Other modes were employed by him, such as the use of a battery in the line-wire, and, best of all, the use of two local batteries to send the current to a primary coil round a core, the line-wire being connected with secondary coils acting by induced electricity. As transmitters these instruments were necessarily somewhat feeble, since the whole of the electricity in the first of the three cases mentioned, and what might be called the operative electricity in the other two cases, had to be derived from the microscopic movements of the disc, under the influence of the sound-wave produced by the speaker.

Edison's phonograph was exhibited, in order to show that a disc, when caused to vibrate under speech, could by a central needle impress those vibrations on tin foil, and that on the tin foil being caused to traverse under the needle, the reproduction on the disc of those vibrations caused it to repeat the speech which had originally set the disc into motion. This was appealed to as a convincing proof that a disc, when mechanically vibrated in a manner corresponding to the vibrations which had been imparted to it by speech, was sufficient, wholly irrespective of any electrical agency, to impress upon the air the needful vibrations to reproduce speech.

Edison then devised a transmitter, wherein the disc need not be metallic, but might be mica, and its vibrations were caused to operate upon a small block of carbon, which carbon was introduced in the circuit of a battery. It was thus found that the almost inappreciable variation in pressure due to the vibration of the disc was sufficient, for some not very well-understood reason, to alter the conducting power of the carbon, and to cause varying currents to be transmitted along the line-wire to the Bell receiver at the opposite end. At the present day the universal transmitting instrument for commercial purposes is the carbon transmitter of Edison, or some modification thereof.

Prof. Hughes' microphone was next alluded to, and it was stated how by its means the most minute sounds were rendered audible, and how, from the delicacy of the instrument, it was applicable to many scientific purposes.

Edison's chalk receiver was subsequently explained. Prior to Edison's time, it had been known that the friction of certain surfaces varied with the electric current passing through them, notably under such circumstances, the friction of the human tissue. Among other appropriate substances prepared chalk was one, and it was shown how Edison availed himself of this. By attaching a stem to the centre of the disc, and pressing this stem by means of an adjustable pressure upon the periphery of a chalk cylinder, a current of electricity passed from the centre of the cylinder through the stem. Upon the cylinder being turned by hand the friction on the stem caused it to move the centre of the disc—its edge being fixed—to a definite position depending on the friction and on the rigidity of the disc; but, on a variation in the current, the change produced thereby in the friction caused the stem either to be drawn in further or to yield to the elasticity of the disc and to allow it to be moved backwards. In this manner vibrations were set up in the disc corresponding with the vibrations of the transmitter that had sent the varying electrical currents. As in the case of this receiver, the power was derived, not from the electricity, but from the hand of the operator turning the chalk cylinder, very considerable loudness was obtained, so that the utterances of the receiver was audible in a large room.

Mr. Shelford Bidwell having been good enough to lend a photophone, that beautiful invention of Prof. Graham Bell was explained. Mr. Bidwell showed how, by speaking to a disc, the front being a mirror, on which a powerful light was directed, that light could be reflected on to a selenium cell, and as the disc vibrated under the influence of the voice the light playing on the selenium cell varied. Selenium was a material the conductivity of which changed with the amount of light upon it. It was therefore possible in this manner to cause a Bell receiver to speak, and reproduce the speech which had been uttered to the mirror disc. It was pointed out that in this manner there was no need of a wire connection between the transmitter and the receiver, the passage of a beam of light being all that was required.

Reference was then made to the various purposes to which the telephone might be put, and to the exchange system and the necessary apparatus for receiving the calls and making the connections between the the different subscribers to the exchange. Amongst special uses, a very interesting one was shown—that of the application of telephony to the diver's helmet. Thanks to the kindness of the captain of the H.M.S. *Vernon* and of Mr. Gorman, a helmet with the whole of the apparatus was exhibited. It was shown how the application of the telephone in no way introduced any complication, as the single wire needed was in the middle of the old call-rope the

return being made by the water itself. Thus, if the telephone went wrong, the diver was left without additional apparatus of any kind to encumber him, and yet with all the resources that he would have had in the absence of the telephone.

It was stated that the development of the telephone had been far more rapid in America than in England. As an instance it was mentioned, that in the city of Washington, with a population of about 120,000 white persons, as many as 800 telephones were used.

Then a return circulated that very day by the United Telephone Company, was read, showing that on the 28th of February, in the year 1881, there were independent of private lines, 845 subscribers to the London Exchange; that on the same day in 1882 the number had increased to 1,505—or an addition of 660; and on the 28th of February this year, the number was 2,541, or an addition of 1,036; and that contemporaneously with these increases, the use of the telephone by each subscriber has augmented, until it now reached more than 7½ calls per day for each subscriber, which—at a cost of £20 year, represented only two pence a call; or, bearing in mind that each call involved a return message, it only amounted to one penny for the message sent each way.

The lecturer was fortunate in having the assistance of Mr. E. H. Johnson, who had been so much associated with Mr. Edison in carrying out many of his inventions, and who was kind enough to put into work both the phonograph and the chalk receiver.

The third lecture of the series will be on "The Electrical Transmission and Storage of Power," by Dr. C. William Siemens, F.R.S., M. Inst. C.E. This is to be delivered on the 15th of March.

THE LUMLEY DYNAMO-ELECTRIC MACHINE.

THE dynamo-electric machine shown in perspective in fig. 1 bears a striking resemblance to several other well-known types. There are, however, some points in its construction worthy of notice, and which, taken together, go to form a very substantial, reliable, and cheap machine. The armature,

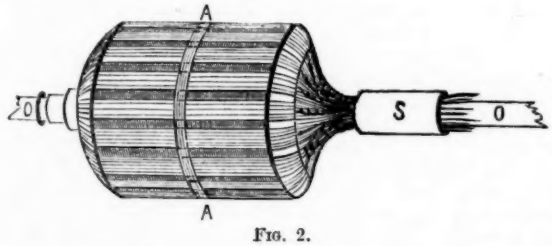


FIG. 2.

A A, fig. 2, is built up of a number of punched discs or plates of the best charcoal iron, No. 16 B. W. G. The internal spokes or teeth of these plates are let into a gun-metal frame or "boss" attached to the steel spindle, and each plate is separated from its neighbours by a brass ring. In the machine we examined, 64 plates with their attendant brass rings made up an armature. The armature is then firmly attached to the axle, O, by means of collars and nuts. It is then coiled with wire, wound in such a manner as to bring

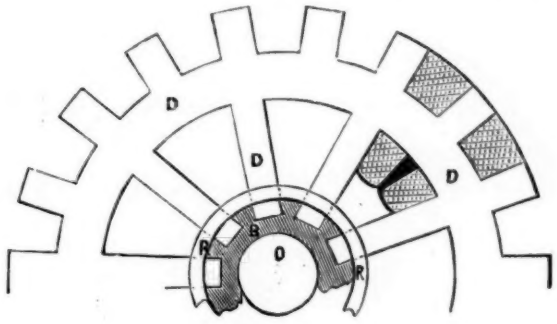


FIG. 3.

both ends of the coil upon the outer surface of the wire. The ends of the coils (18 in number) are passed through a metal collar or sleeve, S, which acts as a bearing at one end of the machine, and are then inserted into holes in the commutator bars, which are slit through, the ends being then firmly screwed down, thus holding the wires tight.

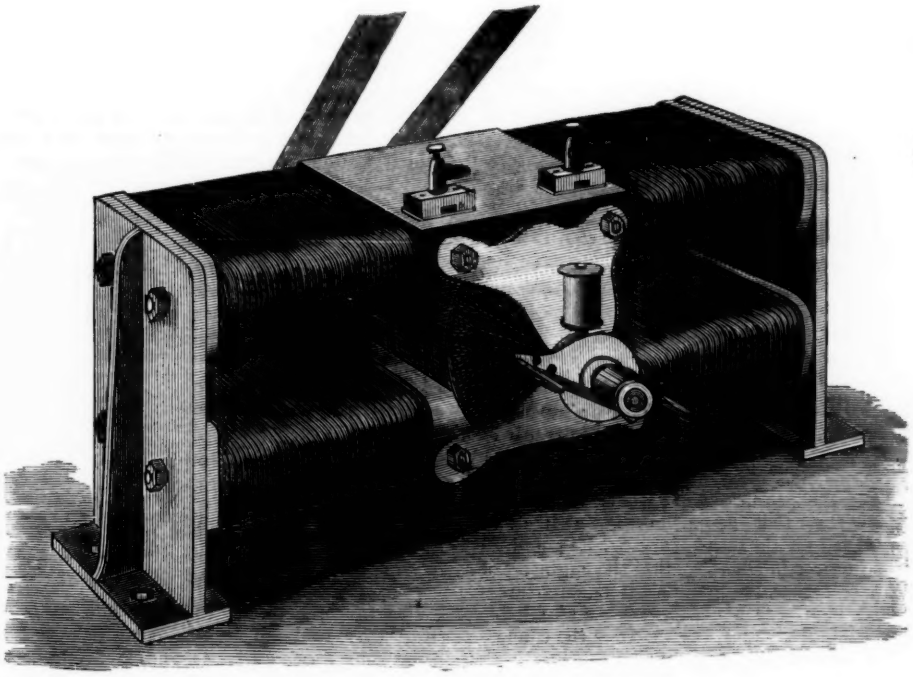


FIG. 1.

This is a convenient and simple way of attaching the coils to the commutator. The field-magnets are of an ordinary shape, the cores being of cast iron and forming part of the frame. In each pole-piece is an opening for the purposes of ventilation. The special construction of the armature is also favourable for keeping it cool. The general arrangement of the machine will be made more clear by reference to the accompanying sketches.

In fig. 3, D shows the shape of the punched plates of soft iron, the internal spokes or teeth of which fit into a grooved "boss," B, surrounding the spindle. R is the brass ring which separates the plate from its neighbour, and O is the axle. The coiling of the wire is shown by the section lines. Fig. 4 gives an outline of the frame and field-magnet cores, M M, and fig. 5 the commutator, into the split segments of which are inserted the ends of the armature coils, which are then firmly secured in their places by screwing down. The

following particulars of the "Lumley" machine may be of interest:—Length of armature, 9 inches; diameter (outside), $8\frac{3}{4}$ inches; number of sections of wire, 18; resistance of armature, shunt machine, ·079 ohms; series machine, about 1 ohm. The resistance of electro-magnets, shunt machine,

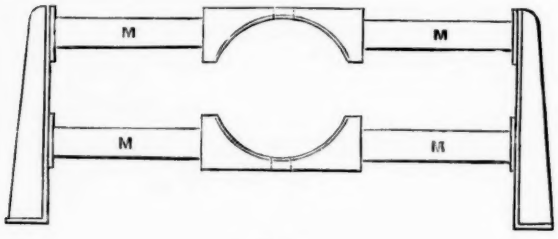


FIG. 4.

7·8 ohms; series machine, about 1 ohm. The electromotive force of the former at the terminals, when driven at about 1,680 revolutions per minute, is 46·25 volts, and the current 74·2 ampères, the machine being adapted for 68 Swan lamps of 20-candle power each. The size of the machine is 2 feet 9 inches × 2 feet 5 inches × 1 foot 2 inches, and the total weight $4\frac{1}{2}$ cwt. The series machine has about four times the E. M. F. of the former, but of course they may be manufactured to almost any desired E. M. F. by special winding,

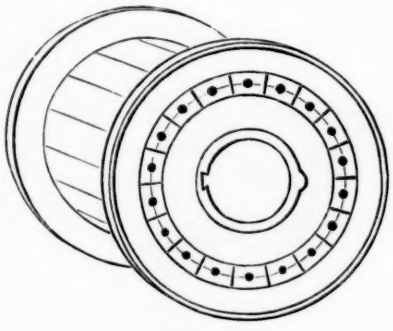


FIG. 5.

The chief advantages claimed for the "Lumley" machine are:—Good ventilation, especially of armature, absence of "Foucault" currents, great strength of armature, enabling it to be safely driven at high speed, and cheapness. Leaving out of the question the patent claims, which we do not know, we may safely state that the machine is one likely to be largely employed, and with satisfactory results; and we believe we are not in error in asserting that the engineers of Messrs. Paterson and Cooper, the manufacturers, entertain a high opinion of its merits, as a cheap, good, and reliable machine. In the general view of the machine the connections are purposely omitted.

Pneumatic Tube Despatch.—The telegraphic messages received daily in Darlington post-office from all parts of the world have for some time past been delivered to the *Northern Echo* office direct by means of a pneumatic tube. Messrs. Cox-Walker and Co., of Darlington, have lately completed a most important improvement in this clever and ingenious apparatus, of which they were the original constructors. Heretofore telegraphic signals have been exchanged between the post-office and the sub-editor's room, announcing the despatch and arrival of messages; but now messages are sent through the tube without preliminary notice immediately on their arrival, and, by a new automatic arrangement, each message, on its arrival in the *Echo* office, reports back to the post-office by telegraph its own delivery. The exact distance between the telegraph-room of Darlington post-office and the sub-editor's room of the *Northern Echo* office, measured along the pneumatic tube, is 450 feet.

INCANDESCENCE ELECTRIC LAMPS.

THE following description of an incandescence electric lamp, patented by Messrs. Woodhouse and Rawson, may interest our readers. This firm for some time past has been well known in the electrical engineering world, and the incandescence lamps made to order alone by them during the last twelve months number between ten and twenty thousand. It is only lately that they have patented and introduced their own lamp to the public, still, however, continuing to make and experiment for other people. Fig. 1

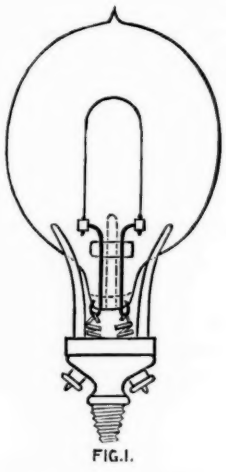
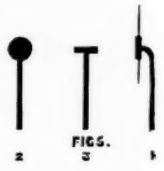


FIG. 1.

shows a general view of the lamp and its holder, which is also a patent. The legs for making connection between the filament and the external wires are made of platinum, which at the filament end is flattened out (fig. 2), and



FIGS. 2 3 4

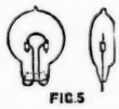


FIG. 5

rolled up by a special tool into a tube (fig. 3), and then bent over to hold the filament which passes through the tube thus formed (fig. 4), and is firmly secured on either side with a specially prepared cement, thus making a good mechanical joint. The other end of the platinum wire is turned into a loop and sealed into the glass as follows: The tube near the bulb is drawn off, heated at the point, and blown till it bursts; the neck is then widened out to receive the filament which is inserted, and the glass pressed tightly on to the platinum leg. This method of sealing in is known as "pinching in."

Every description of lamp is made in Messrs. Woodhouse and Rawson's factory, from 3-candle-power upwards, the different candle powers being made to work with a range of E. M. F. to suit the machines and batteries for which they are made. They also make a speciality of small lamps for batteries, including lamps for surgical and microscopical purposes, which work with two or three cells, of low internal resistance, giving an electromotive force of from 3 to 4 volts and upwards. The surgical lamps are sometimes made flattened on either side as in fig. 5. Lamps of different shapes, sizes, and colours, are constructed for theatrical purposes. The lamps are coloured by a special process after they are finished,

and are found to stand the heat developed. We understand that Messrs. Woodhouse and Rawson can apply this process to any other lamps, or to ordinary globes. The patent holder, as will be seen in fig. 1, is most ingenious, simple, and effective; holding the lamp firmly without putting any undue strain on the platinum loops, it also allows the lamp to be easily changed, if necessary. The small spirals at the bottom prevent any chance of an arc forming and burning the wires through loose contact. This is really the most efficient lamp-holder we have yet seen, and it is suitable for any type of incandescent lamp.

Great care is taken in the testing of these lamps, and they are all specially marked, enabling people requiring fresh lamps to order without difficulty exactly what they want.

The price of all systems of incandescence lamps has fallen very much during the last year—from 25s. to 3s. 6d., which is the price of a good lamp now. This is chiefly due to competition, but, at the same time, the work has been greatly cheapened by systematising it and introducing mechanical appliances. A great reduction has also taken place in the price of labour—for instance, glass-blowers who a year ago were earning as much as from £5 to £7 per week are now content with half this amount, and even less. No doubt through the introduction of glass-blowing machines, and the employment of girls, we shall see a still further reduction. The work in Messrs. Woodhouse and Rawson's factory is now chiefly done by girls, with the exception of the more important part of the glass work, and the exhausting and testing of the lamps.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," Electrical Review, 22, Paternoster Row, London, E.C.

Letters respecting Advertisements, Subscriptions, &c., should be sent to the "Publisher," Electrical Review, at above address.

Subscription Rates.

The Electrical Review can be had, by order, from any newsagent in town or country; or it can be supplied direct from the office on the following terms (payable in advance):—

Half-yearly (postage included)	9s. 9d.
Yearly ,, ,, ...	19s. 6d.

Foreign Subscription Rates.

To all foreign countries (except those mentioned below):—

Half-yearly (postage included)	10s. 10d.
Yearly ,, ,, ...	21s. 8d.

Exceptions:—Abyssinia, Aden, Borneo, Ceylon, India, Java, Labuan, Mozambique, Penang, Persia *vid* Brindisi, Philippine Islands, Singapore, Zanzibar, to which places the rates are:—

Half-yearly (postage included)	11s. 11d.
Yearly ,, ,, ...	23s. 10d.

Vol. XI., handsomely bound, in cloth, gilt, now ready. Vols. 1, 2, 5, 6, 7, 8, 9, 10, can likewise be had.

A few complete sets also may yet be obtained. Prices on application to the Publisher.

Cloth cases for binding The Electrical Review supplied.

Advertisements.

The rates for Advertisements may be obtained on application to the Publisher, Electrical Review, 22, Paternoster Row, London, E.C.

Cheques and Post-office Orders (on Chief Office, London) to be made payable to H. Alabaster.

CORRESPONDENCE.

Electric Lighting.

The inaccuracy of my statement that the exhibition of incandescent lighting at Mr. Macdonald's lecture was the first *public* one in Edinburgh is not very apparent. The installations cited by Mr. Jackson are all *private*, just as the installation of the Maxim light at the General Post-office, Edinburgh, in 1881, was private. Mr. Macdonald's lecture, although delivered under the auspices of the Philosophical Institution, was by no means restricted to its 2,000 members, therefore the exhibition may fairly be called public.

Your Correspondent.

Electric Light Conductors—Insulation.

While several correspondents are discussing the very important subject of maximum safe current per unit of sectional area of copper, the equally important item of insulation has scarcely been alluded to outside the editorial columns in which Mr. Moulton's draft Provisional Order has been discussed.

I have had some experience of underground wires subjected to a very high E. M. F., having had under my charge a five-mile circuit in this town, worked by a 40-light Brush machine. From this experience and theoretical considerations, I have come to the conclusion that a specification for so many megohms per mile is not by itself sufficient for mains which have to resist a high E. M. F.

The mechanical properties of the insulator should also be taken into account, as it seems probable that mechanical toughness and hardness have much influence upon the resistance to disruptive discharge, which is, of course, the chief danger in such cases. Every electrician knows that a sheet of gutta-percha or ebonite, or even dry paper, offers far more resistance to a spark from an induction coil than a layer of dry air of the same thickness, although, tested as a cable dielectric is tested, the air would show an infinite resistance.

The mechanical work expended in penetrating a hard material must be greater than in the case of a soft one, and for different substances there seems no reason to believe that the resistance to disruptive discharge follows that to conduction. The matter is worthy of experimental investigation, the results of which ought to be profitable in more senses than one.

The greater part of my circuit here is rubber-covered cable, giving an insulation resistance of over 200 megs. per mile. The rubber is covered with felt tape and twilled tape, both waterproofed. Some other wire in the circuit is insulated with the felt and twilled tape, and covered with leaden tube. This is in use inside houses and shops. The insulation resistance of this wire is but some 10 megohms per mile. Unfortunately an accident to a lamp-post a few days since earthed the circuit, exposing some of the insulation to an E. M. F. of some 1,200 to 1,300 volts. Some of the lead-covered wire just mentioned had that strain upon it, but nowhere failed. The insulation of the rubber-covered wire did break down, though, at one spot, where the potential was under 700 volts. I am, of course, aware that a single instance does not prove the case.

I should, however, like to see the subject of insulation for high E. M. F. discussed in your columns. Whatever may be thought of the theory advanced, I think it will be acknowledged that the lines of submarine cable insulation will have to be somewhat modified in manufacturing light lines.

Henry M. Sayers.

Eastbourne Electric Light Company, Limited,
March 3rd, 1883.

Electric Light Conductors.

As I have given a great deal of attention to the above subject, perhaps the result of my experiments may be of some interest to your readers. My object has been to make a formula suitable for conductors insulated with india-rubber, of the usual proportions, as manufactured by the Silvertown Company, the rise of temperature in which shall not exceed 25° to 30° Fahr. with the largest amount of current it is intended to pass through them.

My experiments have been very numerous, carefully done, of prolonged duration, and made on actual cables of very varying capacities, from the mean of which I have deduced the following formulæ, which I have found to work out well in practice:—

$$d = \cdot 01286 \sqrt[3]{C^2}$$

$$C = \sqrt{\left(\frac{d}{\cdot 01286}\right)^3}$$

d = diameter in inches.
C = current in ampères.

The conductors on which these formulæ were made had

in no case a conductivity of less than 96 per cent. of pure copper; of course if it were less, or an inferior conductor used, another constant would be required; but with regard to differences in insulation I am surprised to find less variation than I expected within *uncertain* limits, the details of which I have not yet arrived at.

According to these formulæ, to carry a current of 2,000 ampères would require a conductor 2·03 inches in diameter, or about 3·2 square inches sectional area; a square inch of sectional area only being able to carry about 870 ampères.

Electric light leads should be as freely exposed as possible to get the greatest effect of radiation, this may invariably be managed by judicious arrangement, without unsightly appearance except for very short lengths, when conduction and a slight increase in diameter of conductor will generally get over all difficulties.

It is a great mistake to box in electric light leads, as unless the conductors are of exorbitant proportions the accumulative heat will assume a most unsafe magnitude. As an example of accumulative heat, the following experiment will show the effects:—

Length of cable nearly ¼ mile.
Diameter of conductor = ·075 inches.
Resistance ,, ,, = 1·84 ohms.
Current maintained = 14 ampères.

Cable laid out open and free for radiation:—

Resistance after 30′ = 1·91 ohms, rise of temperature = 18·87° Fahr.
,, ,, 60′ = 1·92 ,, ,, ,, = 21·51° ,,

Cable coiled up into coil about 16″ mean diameter, and laid on floor:—

Resistance after 30′ = 2·06 ohms, rise of temperature = 57·08° Fahr.
,, ,, 60′ = 2·25 ,, ,, ,, = 101·68° ,,
,, ,, 90′ = 2·36 ,, ,, ,, = 125·80° ,,
,, ,, 120′ = 2·44 ,, ,, ,, = 142·65° ,,

The experiment was here discontinued for fear of injuring the cable, as, with the temperature of the air added to the rise in cable, it had nearly reached boiling point (212°), and was still rapidly rising.

Fred. Ormiston.

March 5th, 1883.

Dynamo-Electric Machines.

In Professor S. P. Thompson's Cantor lecture on "Dynamo-Electric Machinery," he mentions a patented dynamo of mine in a manner casting ridicule at it, at the same time exhibiting to me his entire ignorance of the method of action in that dynamo and of its parts. As a description may be of interest to your readers, I herewith send drawings (fig. 1).

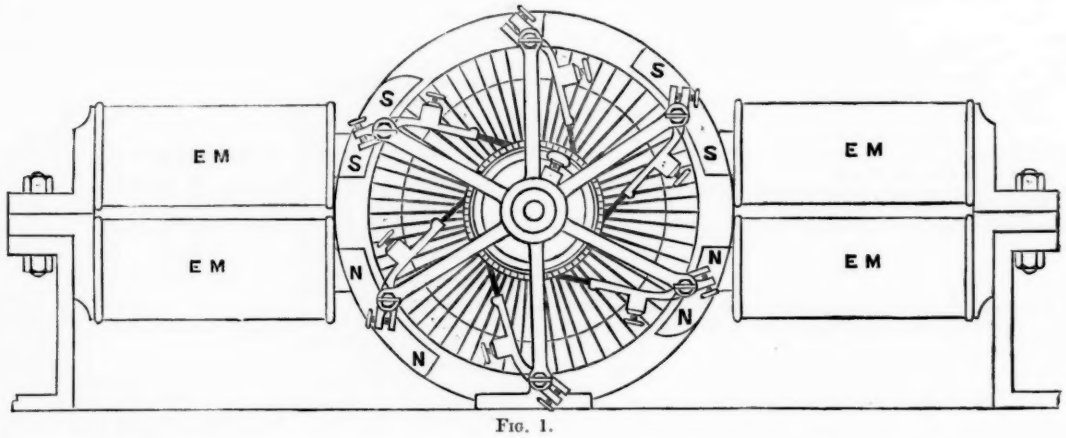


FIG. 1.

The ring armature is precisely similar to the Gramme armature, and so is the commutator. There are six collecting brushes, as shown, three of them being + and three —.

Four distinct and separate polar extremities, S, N, N, S, of the field-magnets are brought up, as shown, close to the ring. This arrangement of poles produces potentials on the commutator, which, if represented by curves drawn by the method used by Professor S. P. Thompson in the aforesaid lecture, would appear as in fig. 2, where depressions and elevations represent — and + points, all the elevations being of equal heights. This being the case, six collecting brushes are rendered necessary.

The advantages are similar to those claimed for the Gülcher dynamo, in which several alternately opposite poles are arranged at equal distances around a ring armature. In my machine they are not alternately opposite poles, and not at equal distances around the ring, and by this arrangement I expect to obtain better results.

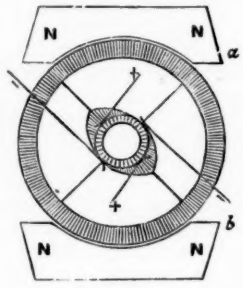


FIG. 3.

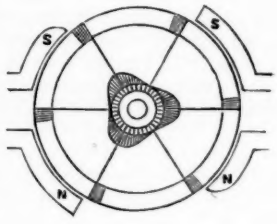


FIG. 2.

I have carried on some experiments on this dynamo, which led me to the designing of a true unipolar dynamo. My experiments were made with a B Gramme ring placed between two similar poles, N N, as in fig. 3, and the potentials formed were found to be as shown there. It is self-evident that four collecting brushes are necessary in this case, as the ring divides into four equal parts—in fact, must be divided into four equal circuits, the space between the pole-pieces, N N, from *a* to *b* is made equal to more than a quarter of the circle, the two pole-pieces enclose less than half the ring.

Rankin Kennedy,
Electrician Railway and Electric Appliances Company (Limited).

The Industrial Unit of Electrical Energy.

The unit of electrical energy, which Mr. F. H. Varley seems to intend to write about, is the volt-coulomb, or vomb; there cannot be any unit of electrical energy which is not some multiple or submultiple of the vomb. This is exactly the same unit as Mr. Beckingsale wrote about, though he made a slip and called it the watt. Your anonymous correspondent, "E.," wrote about just the same unit, only he called it a Joule. The Joule is really the amount of heat corresponding to the vomb, and is not a unit of electrical energy. Some people have great difficulty in realising that 5 per cent. is not a sum of money, and Mr. F. H. Varley seems to have similar trouble in seeing that current and power are simply rates of flow. Current, whether independent of time —whatever that may mean—or not, cannot be expressed in terms of energy, power, or work. ·0003307 grammes of copper is the amount deposited by one coulomb or unit of quantity, and not by any quantity of current. The amount of a substance electrolysed cannot measure the work done in

depositing it, unless the E. M. F. the quantity of electricity passed against, is known. In no case can it be a measure of current. Mr. Varley goes on to explain that two Davys, or units of work or energy, per second would have four times the energy of one, and three Davys per second would have nine times the energy of one, when driving a motor, and I confess I cannot see what he means. Further on he multiplies the Davy by itself and by one second to reduce it to energy, of which, he has already explained, it is the unit. He corrects this, however, and divides the Davy squared by one squared to give it in terms of itself. The plot then thickens considerably, and the D, or Davy, appears as the HD, which evidently is the Humphrey Davy.

While writing about units, may I suggest that it would be much simpler if makers of dynamos, instead of speaking of so many light machines—which means nothing to those who do not know their lamps—would call them so many watt machines? Thus, a machine to run 200 Swan lamps is, roughly, a 10,000 watt machine, and if wound differently for arc lighting or other work is still a 10,000 watt machine.

Jas. Swinburne.

Electrical Measurements.

In last Saturday's issue of your journal, page 185, a correspondent asks how the measurement of the electromotive force, in terms of a Daniell cell, may be ascertained by means of a Wheatstone bridge (slide-wire pattern). May I beg to refer him to a back volume of your journal, Vol. III., page 249, where, I think, he will find the method he is in search of, and which, as will be seen, was first devised by me as far back as November, 1874?

As, however, Mr. Purnell may not have ready access to your early volumes, I will, with your permission, briefly describe the method again, merely altering the phraseology to suit his apparatus, viz., the metre bridge. Fig. 1 shows

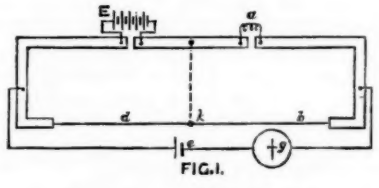


FIG. 1.

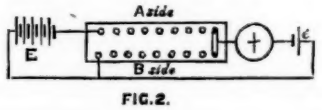


FIG. 2.

the arrangement, and requires no explanation. The cross connection shown by the dotted lines being broken, *i.e.*, the button, *k*, being raised, the resistance in *a* is altered until the needle of the galvanometer, *g*, stands at zero; the button, *k*, is then depressed, and moved up and down the wire until the galvanometer again shows no deflection. These two simple operations give us *data* not only for ascertaining the E. M. F. of the large battery, E, but also its internal resistance. Thus:—

$$\text{E. M. F. of E} = \left(1 + \frac{a}{b}\right) c, \text{ and}$$

$$\text{I. R. of E} = a\,\frac{d}{b}, \text{ or } a\,\frac{1{,}000}{\text{scale reading}} - 1.$$

(For the evolution of these formulæ see my original letter referred to above.)

I may be allowed to add that I have long employed a modification of this test, which gives equally good results, and has, besides, the great advantage of requiring only an ordinary set of resistance-coils. Fig. 2 shows the arrangement, the large resistances being on the A side of the box, and the small ones on the B side. Having pegged in all the resistances on the A side, the resistance on the B side is altered until the galvanometer needle points to zero. Call this resistance *a*. Some resistance, which we will call *c*, is now inserted on the A side of the box (100 makes a convenient factor), and the resistance on the B side is again altered until zero is obtained. Call this new resistance *b*. Then

$$\text{E. M. F. of E} = \left(1 + \frac{c}{b - a}\right) e$$

and

$$\text{I. R. of E} = \frac{a\,c}{b - a}$$

J. J. Fahie.

London, *March* 5th, 1883.

Which is Correct?

At a meeting lately of one of the scientific societies there was a good deal of talk about dynamo machines, the most interesting, if not instructive, part of the discussion being the variety apparent in the pronunciation of the word "dynamo." The chief variations were the following:—

Dȳ′-na-mo,
Dȳ-nam′-mo,
Dȳ-nah′-mo,
Dȳ-nam′-mo,
Dȳ-nah′-mo.

D-n-mo.

The Electric Lighting Act.

May a few remarks about series and parallel lighting systems on a large scale be permitted? Parallel lighting seems looked upon with greatest favour, but the difficulties are not always realised. To begin with, the standard pressure is not to vary more than 10 per cent. Using your pages for easy reference—*see* p. 84 (*c*). This reads as if it might vary 10 per cent. each way; thus, if 100 is the standard pressure it may at one time be 90, at another 110. This puts incandescent lighting out of the question at once. If the lamps were of the same resistance hot as cold, a variation of from 90 to 100 volts would mean a variation of power expended of from 100 to 150. As the resistance under the high E. M. F. would be about two-thirds of that under the low, or perhaps less, the power spent would vary from 100 to 225. This is, of course, out of the question. It was no doubt meant that the standard pressure should not vary more than, say, from 100 to 110. Even then, on an unvarying resistance the power spent will vary from 100 to 121; and in glow lamps it may vary from 100 to 150. No glow lamps will stand this, unless run at a very low efficiency indeed. But, granting that glow lamps can be used in spite of an increase of 10 per cent. pressure, the difficulties to be met in leads are enormous. Imagine, for example, a street a mile long, consisting of 100 consumers, stretching away from a central station. Imagine that each consumer uses 10 glow lamps. Each glow lamp takes 100 volts and one ampère. One of these lamps would correspond to two Edison lamps in parallel, or two Swan's in series. The current supplied by the dynamo, setting leakage aside, would be one thousand ampères, and some regulating device would be used to preserve 110 volts on the terminals of the circuit. The leads must now be designed as economically as possible, to use as little copper as possible, and as little power as possible.

When all the consumers are consuming hard the standard pressure of 100 volts must be available at the far-end of the street, and the pressure at the near-end must not exceed 110 volts, otherwise if all the consumers but the most distant stop consuming, the pressure at the distant-end will rise above 110, the resistance of the leads being no longer sensible in proportion to the few lamps in use. Few companies would care to spend 10 per cent. of their power in their leads, even as a maximum, but it may be allowed here. The leads will not be the same diameter all along, but will taper, the sizes being calculated, as this takes least copper; but even then, and allowing 10 per cent. waste of power, the leads at the station must be 3·46 inches in diameter. Imagine putting down two three and a half inch shafts of copper to carry only 1,000 ampères! A return wire is allowed for here, as earth returns are impracticable with heavy currents. The pressure was taken at 100 instead of 400, because it is very troublesome to install glow lamps in multiple-arc, as they cannot well be turned off one by one, and waste being caused. There are no lamps to run on 400-volt circuits in parallel. Such lamps of twenty candle-power are either very difficult to manufacture or else they

are either inefficient or not durable. Mr. Edison is said to make lamps of 1,000 ohms cold. These would take about 240 volts if they are twenty-candle lamps. I have not seen these, however; only heard of them.

If a series system be used a difficulty immediately arises about danger. Suppose we have a dynamo giving 10 ampères whatever the resistance in the circuit. The dynamo would not be called upon then for more than 10,000 volts, of which each consumer would have 100, in the before-mentioned street. An automatic cut-out could easily be made to short-circuit any consumer out who had more than 10 ohms resistance in his circuit, and put him in circuit again when he had less. If, however, a consumer were to disconnect his wire by taking it in one hand and the service terminal in the other and disconnecting, he would get a very powerful induction shock, and at least 10,000 volts, and be killed instantly, before the automatic arrangement could save him. Something corresponding to a lightning arrester might shunt the induction shock; two points in an imperfect vacuum, for instance. Secondary batteries would also do in shunt circuit, but 50 cells would be needed; and if current is to be supplied all day they would not be used in houses. It is questionable whether they would be used in series lighting just yet. Sixty tiny unformed Planté cells in series would not let any current through ordinarily under 100 volts, but in case of accident they would save life probably, as their resistance would be little in comparison with the body. In supplying a few consumers during the day the parallel system would be comparatively more economical, unless in the series system one ampère, for instance, instead of 10 were supplied; the power spent in leads would then only be one hundredth of ordinary expenditure. The whole system of series lighting for houses is put aside by clause (*h*) of regulations for safety, p. 128. No lead is allowed to differ from earth in potential more than 400 volts. If the system be properly insulated there can be no danger from an occasional earth contact through the body. If one wire were above the earth and the other below by 5,000 volts, and contact was made with one only, very little electricity would flow. Suppose the capacity of the system were as much as a microfarad, only one two-hundredth of a coulomb would pass. On touching the other wire afterwards ·01 coulomb would pass. The danger is, however, that the dynamo may leak. If secondary batteries are anywhere on the circuit they are also a fruitful source of leakage; but except near the dynamo there cannot be two earth contacts with dangerous difference of potential close together. Surely the insulation can be made good enough to allow series lighting without danger, otherwise how are long circuits to be dealt with? With alternating machines there is of course no danger of ground circuits through secondary batteries.

It is questionable if alternating machines can be used economically on long circuits. Firstly, because long conductors have considerable capacity, must be charged and discharged to more than the average potential of the leads; and secondly, because induction impedes the alternating currents. These two objections are greatly magnified when many wires are close together underground. The frequency of alternation, p. 84 (*e*), of 300 a minute seems much too small. Helmholtz gives 24 impressions a second as the number perfectly blended by the eye. 300 a minute only gives 10. Apart from this, if glow lamps with fine filaments are used, they must be run at very low efficiency, or else they may be broken.

In the conditions as to price (2), charging by quantity alone is mentioned. This probably takes a uniform pressure for granted, and refers to parallel lighting. Measuring the energy with a uniform current in series lighting is much simpler, (3) provides for time charging, and it might be taken for granted that the consumer used his whole available pressure, as he could not conveniently use less, and his whole current, which he must use. Mr. Shoolbred points out that a small current with a high E. M. F. can be supplied cheaper than a large current at a low pressure. This is important, and is not contemplated in the Act. By-the-by, even Mr. Shoolbred is careless about units, and is blind to the beauties of the vomb, and occasionally writes the watt as the unit of electrical energy.

James Swinburne.

[Is not our correspondent mistaken in the size of conductor for 1,000 ampères?—EDS. ELEC. REV.]

NOTES.

Electric Lighting.—The Electric Light Storage and Engineering Company, Wolverhampton, is doing a very satisfactory business, chiefly in storage batteries. At present a battery of fifty cells is in course of manufacture for private lighting in the metropolis, upon the Edison system. The size of battery generally constructed for the Swan system is twenty-two cells. Practically noiseless, high-speed engines, of from 3 horse to 9 horse-power, some of which will be capable of running 1,000 revolutions per minute, are being built for driving electric machinery.

The French gas companies have established at their common expense a laboratory for testing the several inventions reported in electric lighting and proving their values.

It is stated that Mr. Burt, M.P., has already received some hundreds of communications in reply to Mr. Lever's offered premium for a portable safety electric or other lamp. M. Mangin lately demonstrated the safety of his miner's electric lamp by placing it in the middle of a balloon filled with hydrogen. The apparatus consists of a Swan incandescent lamp immersed in a glass globe containing water. The light is further intensified by a copper casing silvered inside, and one or more strong lenses.

The representative workmen of Newington held a meeting at Temple Bar Hotel, Walworth Road, on the 24th ult. Mr. J. A. Giles was called to the chair, and reported that the resolutions adopted at the meeting on the 19th ult., condemning the scheme of the Newington Vestry, had been despatched to the President of the Board of Trade, and an answer had been received from Mr. Chamberlain, stating that if the licence was proceeded with an inquiry would be held, of which ten days' notice would be given, when the committee would have an opportunity of stating their objections. A hearty vote of thanks was accorded to the President of the Board of Trade for granting a public inquiry into the proposals of the Vestry, and a sub-committee of ratepayers appointed to canvass the whole parish and collect evidence to lay before the Commissioners.

The new station and harbour of Parkeston, near Harwich, which the Great Eastern Railway Company intends to substitute for the latter place as a depôt, was partially opened on Thursday, we believe. From what we can gather an attempt has already been made to use the electric light there for general illumination by means of a Brush machine and secondary cells. Apparently the result was not successful. The engineer of the Great Eastern Railway, after conferring with Messrs. Laing, White, and Wharton, of Holborn Viaduct, the representatives of Swan's system, finally accepted an estimate for Swan's incandescence lamps, and it is proposed to use 250 high resistance 20-candle-power lamps requiring an E. M. F. of 100 to 110 volts and a current of ·6 ampère each. We understand that the main conductors for this installation are covered with Callender's patent vulcanised bitumen insulation. The fittings for the lamps, &c., are supplied by the above-mentioned firm.

We understand that Messrs. Siemens Brothers have in hand the lighting by electricity of the Cunard steamer *Aurania*, with 500 20-candle-power lamps of the Swan type, the current being supplied by two Siemens machines of the continuous current system, each to supply 400 lamps and each connected with a Brotherhood engine.

We hear that the Jablochkoff candles have given great satisfaction at Wakworth Harbour, near Newcastle, and that they are likely to be adopted for permanently lighting the place.

In the Strand the "Gaiety" will be illuminated by means of 30 Jablochkoff candles and 40 Swan lamps some time during next week. This system should really be the best for working arc and incandescence lamps on the same circuit, as the distance apart of the carbon pencils in the candles is a fixed one. The variation of resistance in the arc should, therefore, be less than in any other lamp that we know of.

We read that the electric light is now in full use in the large rooms of the Oxford Union Society, an engine-house having been built in the garden close to the new debating hall. The flickering of the arc lights at present in

use has not been found to have an encouraging effect on the oratory; and they are shortly to be replaced by 100 incandescent lamps. It is expected that the prime cost of the undertaking will amount in all to about £1,250, and the society does not expect to save any money, directly at any rate, by the substitution of electricity for gas. One indirect advantage, however, will no doubt be that the books in the library will not suffer so much.

The Electric Carbon, Storage, &c., Company of Scotland has received instructions from Messrs. Logan and Heslop to light throughout the Theatre Royal, Edinburgh. Self-regulating dynamos and storage batteries will be used.

An Exhibition of the Edison electric light was opened at 104, George Street, Glasgow, on Friday week and has been very favourably commented on by its numerous visitors and the Press. The beautiful globes and a 300-candle incandescent lamp, claimed special notice.

We understand the Edison Company contemplates the establishment of a number of branch offices throughout Scotland, all of which will be under the management of Mr. C. T. Grant, who is at present superintending the Glasgow exhibition.

It is said that the executive of the International Fisheries Exhibition have decided to light their galleries by electricity, and that arrangements have already been made for the illumination of fully two-thirds of the area. The committee will thus be enabled to keep the exhibition open later than was originally intended.

Mr. Nathaniel Stevenson communicates to a medical contemporary the following particulars of his electric lamp:—"The lamp that I have taken so much pains to produce for the illumination of interior cavities is an incandescent carbon lamp, protected by an outer glass shade, mounted in such a way that there is a free access to the external air between the two glasses to neutralise the heat. The carbons used are 1-100th of an inch in diameter, and vary in length from 1-10th to ⅜ of an inch; consequently in using a bichromate battery with a reserve force I am obliged to construct a rheostat, because it is the easiest thing possible to fuse the carbon filament."

Electric, Gas, and Engineering Exhibition.—An exhibition of electric, gas, and engineering appliances was inaugurated at the St. James's Hall, Manchester, on Saturday last. Owing to circumstances over which the promoters had no control the details are yet incomplete.

The Brush Electric Light and Power Company of Australasia (Limited).—Creditors of this company must send in their claims to the liquidators by April 10th next. It is added that this notice "has no reference to claims against the Australasian Electric Light, Power, and Storage Company (Limited), to which company the above-named Brush Electric Light and Power Company of Australasia has sold its patent-rights."

The Royal Aquarium Electrical Exhibition.—The announcement of the opening of this exhibition last Saturday drew a large number of visitors, but scarcely any of the exhibitors had their arrangements ready. With the exception of Siemens' arc lights, the Swan incandescence lamps shown by Messrs. Edmundson and Co.—certainly the most tasteful display of all—the Edison lamps in some rooms in the South Gallery, and the illuminated grottos of Dick Radcliffe and Co., the well-known horticulturists, nothing was to be seen in the electric lighting way. Probably, however, by next week matters will have come to a more advanced state, and we shall from time to time deal with the exhibits in detail. We hope that Mr. Gooch, the engineer to the exhibition, will see his desires realised, and that the work he has so energetically undertaken will yield results of value to the electrical world.

The Brush Electric Light and Power Company of Scotland (Limited).—The secretary of the above company writes to us, to correct the impression that the Electrical Power Storage Company undertook the lighting of the hall on the occasion of the science lecture delivered by Mr. Macdonald, Q.C., Dean of Faculty of Advocates, &c., at Edinburgh, on the 20th ult. The Brush Electric Light and Power Company of Scotland carried out the arrangements and sent up the batteries, which were the property of the company. Mr. Frederick White, of London, rendered every assistance in respect of the batteries, but was not actually in charge of the installation.

Gas v. the Electric Light.—Mr. H. Woodall, as president of the Midland Association of Gas Managers, on the 16th inst. delivered an address at the annual meeting. He could not help remarking that for the lighting of streets, squares, and railway stations the electric light is really more unsuitable, and at the same time more assailable, than in any other sphere. He was speaking of the arc light, the incandescent being a luxury which only a very limited number could hope to indulge in. What, he asked, were the demerits of gas for lighting purposes, taken from the mouths of its detractors? Its heat, smokiness, and deleterious fumes. What were the merits of the electric light? Its freedom from these defects. What were the merits of gas for lighting purposes? Constancy, warmth of tone, divisibility, and consequent dispersion of shadows. What were the demerits of the electric light? Inconstancy, coldness of tone, and shadows more or less intense. Apart from cost, therefore, gas afforded without doubt the better light for outside purposes. What as to cost? Now in this connection it was essential that we remember that our selling price of gas yields a profit which, in the case of corporations owning gasworks, goes in one form or another to the public. He thought he should be able to show that where the supply was intrusted to a company the public had an almost equal advantage. The price at which gas was sold was no indication of its cost, and where corporations possessed the gasworks it was actual cost which needed to be taken into account in the matter of public lighting. What did it matter whether the undertaking had been bought cheaply or dearly, or whether 6d. or 2s. 6d. per 1,000 feet was required to meet the charges for interest upon the capital expended? Be the capital great or small, it was sunk; and were gas abolished, the liability of the public in regard to it would still remain—that is to say, all the charges for interest would have to be met just as before. Taken in this light, gas was as secure in the field of public lighting under corporations at 3s. 6d. as at 2s., because where it was 3s. 6d. the actual cost of production and distribution was no greater in the one instance than in the other, the difference in price being attributable to the greater cost of the works or the difference in policy pursued in dealing with profits. Let him take the town of Leeds to illustrate his meaning. They had expended a round million in their plant, the interest on which amounted to about £40,000 a-year, which was a charge of about 8d. per 1,000 feet on the gas sold. They had a margin of profit at their price of 1s. 10d., which was equivalent to 2d. per 1,000 feet. The cost of the gas made and distributed was therefore 1s. per 1,000 feet. But of this shilling, at least one-half was for managerial and other charges, which were fixed, and were barely disturbed by a varying sale of gas—that is to say, the costs of distribution, collection, maintenance of mains, &c., were about £40,000, which amount would continue practically undisturbed, whether the sale be diminished or largely increased. Sixpence, then, was the cost of gas in Leeds to the corporation; and were it to be supplanted in any direction, the difference between 6d. and 1s. 10d.—*i.e.*, 1s. 4d., would be abstracted from the profits of the corporation, and would have to be met by a higher charge upon the remainder of the gas sold. What was true of Leeds was true of every other town where the supply was in the hands of the corporation. Could electricity compete on such terms? Six to seven hundred candles could be supplied at a cost of a penny an hour, and that not in necessarily concentrated quantity as with the electric light, but distributed at the will of the lighting authorities.

The Origin of the Volt-Ampère or Watt.—The employment of this unit of energy has become familiar to electricians since Dr. Siemens proposed it and gave it a

name at the meeting of the British Association held at Southampton in September, 1882. We would observe, from a historical point of view, that this unit is older than might be imagined, for we read in *Comptes Rendus des Travaux du Congrès International des Électriciens*, third public sitting of October 11, 1881, page 378, as follows:—"M. Latchinoff, Russia . . . . The speaker then called the attention of the meeting to the unit of energy, corresponding to the ampère and volt,* and equal to 10^7 ergs. This unit was employed in almost every calculation, and, having no special name, M. Latchinoff thought proper to recommend the Commission des Unités Electriques to choose one for it."

Another New Danger.—The telephone and the electric light have, says a contemporary, added new danger and discomfort to the London streets. What with laying or relaying wood pavements and sewer and gas and water pipes, the streets have long been in a chronic state of repair. But now to all existing evils is added the tearing up of the pavements in all directions for the purpose of laying telephone or electric wires. As these are a novelty, every place where the operation is going on attracts a crowd of the most industrious population in the world, which somehow always seems to have time on its hands, and the congestion on the traffic thus caused has a tendency to aggravate the original nuisance. Would it not be well if the private companies were to be compelled to bury all their pipes and wires in one box or subway, and to give notice before they open it, so that one opening might do for all?

Good; but what about the interrupted wires while the notice was being noticed and the necessary warrant given for the opening of the box? In the cases of telegraphic, telephonic, and electric lighting, interruptions and delays are inconvenient and dangerous; therefore a general warrant is a necessity.

Legal.—In the Court of Session, Edinburgh, on Saturday last, application was made for a supervision order in connection with the winding-up of the Universal Electric Appliance Company, now in liquidation under petition by the New Glenduffhill Coal Company (Limited). The agent for Messrs. Mure and Company, engineers, Manchester, who had executed a poinding of certain machinery prior to the presentation of the petition, and who had claimed a preferable ranking, stated that if he was found entitled to a preference he had no objection to the supervision order. This was allowed, and the Lord President said parties could settle the whole affair in five minutes, and continued the case.

In the Court of Session (Outer Division), Edinburgh, on Thursday week, the case of Guild *v.* Hope and the Scottish Brush Electric Light and Power Company came up for hearing. The Lord Ordinary allowed the name of Mr. Hope to be withdrawn and that of Mr. Molleson, C.A., as liquidator of the company, to be substituted as a defendant. It was understood that he was to adopt Mr. Hope's plea that the plaintiff was to receive a commission only on his floating the company, and also to plead that in any event Mr. Hope acted as an individual only and in his private capacity, and not as representing the company.

The Cost of Telegrams.—Dr. Cameron has given notice that on an early day he will, on the House of Commons going into Committee of Supply, call attention to the charges for postal telegrams, and move a resolution.

Telephonic.—Telephonic communication between the Edinburgh and Glasgow exchanges of the National Telephone Company, Limited, has been established. The wires go by the Midcalder, Holytown, and Coatbridge route of the Caledonian Railway.

The Volta Prize.—The Volta Prize of £2,000 offered by the Académie des Sciences for the best economical application of electricity, will be awarded in December, 1887. The competition, open to foreigners, closes on the 30th June, 1887.

* The power required to raise a coulomb to the potential of a volt.

Science Lectures at Bradford.—Last week the first of a series of science lectures on "The Technical Application of Electricity" was delivered at Bradford by Professor A. W. Rücker, M.A., M.S.T.E. & E. The lecturer dealt with the measurements of electricity, and the units and apparatus employed.

Assessing the Telegraph Wires.—At a recent meeting of the Helston Board of Guardians it was stated by Mr. F. V. Hill that Mr. Jeffery (of the Direct Spanish Telegraph Company) had been over from Falmouth, and did not object to the principle of rating but to the amount. All parties then agreed to £2 per mile on $2\frac{3}{4}$ miles. It was resolved to ask the assessment committee to meet again in a month and look into the whole question.

The Royal Society of Arts (Edinburgh).—At the meeting of this Society on Monday week, Dr. Ferguson communicated a paper "On an Electric Gas Lighter, and on Miniature Induction Coils and Batteries invented by Charles L. Clarke, Manchester." In our issue of December 9th last, we noticed Mr. Clarke's invention, so that it is unnecessary to repeat that notice. In answer to a question, Mr. Clarke said that a gentleman present had experimented with his miniature batteries on the telephone between Edinburgh and Greenock, with the result that he could hear better with the two small batteries than he could with the large Leclanché. Dr. Ferguson and Mr. Clarke received hearty votes of thanks at the close.

Accident to a Telegraph Ship.—On Friday week the new telegraph steamer *Viking*, while being shifted from the Camperdown to the King William Dock, ran against the quayhead, doing considerable damage to the woodwork below watermark and twisting her own stem. It is expected that she will require to be docked before any real estimate of the damage done can be made.

Proposed Telephonic Communication between Parliament and the Exchange.—Mr. Shaw-Lefevre, replying to Mr. Ritchie on Friday week, said he hoped in a few days to put the House of Commons in telephonic communication with the Telephone Exchange.

The Telephone in Dundee.—In connection with a note we published in our last issue we may add that on Monday last the Plans and Works Committee of Dundee authorised the National Telephone Company to erect thirty-eight new lines. A proposal is on foot to connect the cemeteries, and will doubtless be *gravely* considered.

Telephony in Paris.—The telephonic system in Paris, which, on November 1st, 1880, numbered 454 subscribers, had 2,392 at the beginning of this year. The service is now divided among 11 stations. The length of wires between subscribers and stations is now 3,500 kilomètres (say 2,187 miles). The line system is entirely subterranean. The wires both between the subscribers' places and the stations, and between the stations themselves, are joined in cables and suspended in the vaults of the sewers. Each cable contains 14 insulated conductors, forming seven double lines. The mean length of a line between a station and a subscriber is 1,146 mètres (say 3,820 ft.), and 170 auxiliary lines connect the 11 stations together. The subscription in Paris is about 600 fr. for a line, 1,100 fr. for two lines, and for three or more in the name of one subscriber 500 fr. per line. For these sums the company constructs the line, furnishes and fits up the apparatus for the subscriber, maintains it, and by night as well as by day gives all the communications asked. As regards instruments there has been unification, and the Ader transmitter and receiver are now furnished to all subscribers. At the stations 103 girls provide nearly 20,000 communications per day, or an average of eight communications per subscriber per day. The day service is wholly provided by girls; the night service by men, to the number of 35. There are about 1,000 communications by night from 7 p.m. to 8 a.m.

Underground Wires in Chicago.—The time fixed by the City Councils of Chicago for the removal of the telegraph wires and poles is May 1. The ordinance will be enforced to the letter. A franchise has been given the Chicago Sectional Underground Company to open the streets and construct and maintain underground conduits for the use of the telegraph and telephone companies, and it has already begun work. On January 30, Mr. E. S. Dreyer, representing the company, closed negotiations with Mr. W. H. Johnstone, president, and Mr. J. Ensign Fuller, manager of the American Sectional Electric Underground Company, of Philadelphia, for the purchase of the system of laying underground wires owned by that company. The conduit or tunnel which will be used is a cast-iron box, four inches square, which will be laid in the streets on the side opposite the water-mains, at the depth of about 20 inches. Each tunnel will hold about 50 electric light wires, and between 400 and 500 telephone and telegraph wires. At intervals of about 20 feet there will be openings through which any wire in the conduit can be tapped for either lighting, telephone, or telegraph purposes.

Telegraph and Telephone Wires across Streets.—The Wandsworth Board of Works met recently, when the General Purposes Committee reported the receipt of a letter from the secretary to the General Post-office relative to the resolution of the board declining to allow the proposed telegraph wires to be fixed across certain streets at Tooting, and to the request of the board for the removal of the wires which had recently been fixed by the Post-office authorities across streets at Putney and Battersea. The letter stated that the wires at Tooting and Putney were for fire alarm and police purposes, and that where single wires had to be carried over a considerable distance, as was the case in these instances, the cost of placing them underground was quite prohibitory. Under the Telegraph Act, 1878, in the case of way leave being refused by the body having control of public roads, the department had power to appeal to the police or stipendiary magistrate of the district for his arbitration. The letter also expressed regret that, through an oversight, the consent of the board was not applied for in the case of the telegraph wires recently erected at Battersea. The committee recommended that the board adhere to their previous order requiring the removal of the wires in question. The committee reported that they had also considered the subject of the wires erected by the telephone company across public streets in Putney, and recommended that the board adhere to their former order in the matter and insist upon their removal. The committee's recommendations were adopted.

The Telegraph Clerks' Grievances.—Meetings of postal telegraph clerks connected with the more important offices throughout the kingdom continue. At Glasgow the secretary to the Glasgow Branch of the United Kingdom Telegraph Clerks' Association has been suspended, ostensibly for posting a notice calling a meeting in the retiring-room without official sanction.

Telegraphic Communication with Lighthouses.—In the House of Commons, on the 23rd ult., Mr. Chamberlain, in answer to Mr. Vivian, said he had made inquiries and found that the question of establishing telegraphic communication between the shore and outlying lighthouses had received for a long while the careful attention of the Trinity Board and the Board of Trade. For himself, he was not quite certain that the result to be attained by such a communication as proposed would justify the very large expenditure which would be incurred; but he had been anxious that the experiment should be made, and some time ago he learned that the Telegraph Construction and Maintenance Company was willing to try the experiment for twelve months, at its own risk and cost. He sanctioned the experiment, with the provision that if successful the Trinity House should purchase the cable and apparatus for £3,730, and that the determination as to whether the experiment was successful should be left to Sir James Douglas, of the Trinity House Corporation. This the company objected to, and for the moment negotiations were broken off; but he hoped that before long some arrangement would be come to whereby the experiment might be tried.

Science Lectures in Edinburgh.—On the evening of the 23rd ult. Mr. J. H. A. Macdonald, Q.C., Dean of Faculty, and Associate of the Society of Telegraph Engineers and Electricians, delivered to the members of the Edinburgh Philosophical Institution the second of his two lectures on "Electricity: it Characteristics and Uses." As on the previous occasion, the hall was quite crowded. Beginning by referring to the relation between magnetism and electricity, the lecturer explained and illustrated the different characteristics of magnets, and passed to the consideration of dynamo machines and accumulators. The second portion of his lecture—that dealing with the uses of electricity—was next taken up, attention being directed to modern and antique systems of telegraphing. The telephone was referred to, and here the lecturer pointed out that it was not the voice of the speaker that was heard through the instrument, but merely the sound vibrations which were caused by the voice, and which were electrically recorded at the receiving end of the wire. Having exhausted this department of his subject by alluding to the wonders and eccentricities of the microphone, the lecturer proceeded to speak of the application of electricity to purposes of illumination, mentioning that there were at present two modes of electric lighting—by arc lamps and by incandescent lamps. To satisfy his audience that there was no danger of fire from the breaking of an incandescent lamp, the lecturer covered an Edison lamp with a fine handkerchief and then smashed it. The demonstration was received with applause. Proceeding, Mr. Macdonald remarked that electrical energy was now becoming enormously useful for mechanical purposes of all kinds, and by its means motive energy could be transmitted to long distances. One of the great advantages of this power was the minuteness of its capabilities. By its means we could measure the speed of a shot from the time it left the bottom of a gun till the time it reached the muzzle, and correctly estimate the rate of every foot of its progress; we could reckon with with the most perfect accuracy the speed at which a ship sailed; and we could steer a ship, say, from Glasgow to Liverpool without having to attend to the wheel. In concluding, he said he hoped he had been able to give his audience some insight into the wonders of this great power, and he trusted that they would continue to take an interest in the subject, for electricity was undoubtedly the great power of the present time for mechanical purposes. It was just beginning to be really developed, and he did not think any one could foresee the length to which its application would be carried. This lecture, like the preceding one, was illustrated by numerous diagrams, apparatus, and experiments. The portion of it dealing with electrical illumination was illustrated by a number of Edison and Lane-Fox incandescence lamps, supplied from 25 accumulators of the Faure-Sellon-Volckmar patent. A 1,500-candle-power arc Brush lamp was suspended from the roof of the hall. The lighting of the hall was even better than on the preceding evening, the lamps being somewhat differently arranged.

The Vienna International Electrical Exhibition.—For this exhibition, which, as we have before stated, is to be held in the Austrian capital in the months of August, September, and October next, applications for space are still very numerous, and among the exhibitors will be representatives from America, Belgium, England, France, Germany, Italy, Russia, Sweden, and Switzerland. Among the principal features of the Exhibition we may mention the exhibits of the Société Anonyme d'Electricité at Paris, which will include no less than eight different dynamo-electric machines, three electro-motors, lamps of different systems, microphones, telephones, secondary batteries, telegraphs on new systems, a regulator for lighthouses, &c. This society will also exhibit a dynamo-electric machine for serving 100 arc or 1,000 incandescent lamps. Professor C. W. Fenger, of Prague, has announced a rich collection of scientific instruments and apparatus, among which are a universal rheometer, a universal electrometer, a new gas-column, and a new accumulator; and E. Hartmann, of Wurzburg, who has gained an acknowledged reputation by his instrument for Prof. Kohlrausch, the prominent natural philosopher, promises a considerable number of scientific instruments and other apparatus. Charles Foster, of Birmingham, will exhibit, besides apparatus for studies, batteries for electric lamps, and electric

toys. In connection with the engineering firm of E. Skoda, of Pilsen, Piette & Krizik are to bring forward a steam-engine of 60 horse-power, six dynamo machines, regulators, &c., also 60 arc lights; and Buss, Sombart & Co., of Magdeburg, will exhibit a rich collection of illuminating apparatus, tachymeters, &c. The Compagnie Continentale Edison, and the Société Electrique Edison, of Paris, who represent the system of the great inventor from Menlo Park in Europe, intend forwarding the complete installation of a dynamo-electric machine for 500 incandescent lamps. A highly interesting announcement to intending visitors generally will be that of the Wiener Privat Telegraphen-Gesellschaft, which, by effecting telephonic communication between the Opera house and the Rotunda, will afford them an opportunity of enjoying the opera nightly. The telephone will also have representatives in Heinrich Machalski, of Lemberg, who raised some little excitement at the Paris Exhibition by his telephonic communication between Paris and Le Mans, a distance of 500 kilometres; Zellweger & Ehrenberg, of Uster (Switzerland), who attained great success in Munich, and who have furnished many cities in Switzerland with telephonic installations; Mourlon & Cie., of Brussels, and Stefan Horner, jun., of Budapest, who will exhibit loud-sounding musical and conversing phonophones. Galvanic batteries, accumulators, and thermo-electric batteries will be represented by Gaston Planté, of Paris, the inventor of the secondary batteries; Johann Weichmann, of Munich; Rebicek, of Prague; Popper, H. W. Adler and Cie., Daniel Lautensack, and Deckert & Homolka, of Vienna; as well as by Ferdinand Crestin, of St. Petersburg. We may mention that Dr. Michael, of Hamburg, will present a lighting apparatus for medical purposes; Dr. Isidor Wilheim, of Vienna, an electrolytic battery, and Dr. Hedinger, of Stuttgart, a battery for galvano-caustic purposes and an electric mirror for lighting up cavities of the body. In regard to telegraphs and the application of electricity on railways, the Austro-Hungarian Company of state railways will exhibit an interesting collection of signals and other apparatus, among which will be numerous inventions by the well-known Inspector Pollitzer, and an interesting type-printing apparatus by Johann N. Teufelhart, of Vienna. Gravier, of Warschan, Piette & Krizik, of Pilsen, and others, will also exhibit largely in this department; and for their experiments more than 300-horse water power will be at the disposal of the commission. The electric railway leading from the Praterstern to the Rotunda will form an attractive illustration of this most modern application of electricity

We are officially informed by the secretary of the Society of Telegraph Engineers and of Electricians that the Crown Prince of Austria has consented to become patron of the exhibition, and that the Emperor has signified his intention of devoting some highly decorated rooms for the purpose of testing the effects of incandescent lighting in connection with various styles of decoration. We had, however, already mentioned these facts in our issue of February 24th.

The time fixed for the receipt of applications for space has been extended from the 1st to the 20th inst., by which latter date they should be in the hands of the secretary of the society, 4, The Sanctuary, Westminster.

We are also authorised to state that the committee at Vienna are making arrangements for a reduction of the rate of transit on all goods forwarded to Vienna for exhibition.

Reply to M. Ledieu on the Subject of the Analogies between Hydrodynamic and Electric Phenomena.—By M. C. Decharme.—M. Ledieu has replied to my objection. I confine myself in this answer to certain essential facts and to general considerations.

I point out first that my hydraulic imitations of electric phenomena do not extend merely to the mechanical effects of attraction and repulsion—M. Ledieu's principal point of attack—they extend to the luminous thermic and chemical effects of statical and dynamical electricity.

Besides these so exact imitations of the various manifestations of electricity there is one of another nature upon which I ought to insist; it is that of the electro-chemical rings of Nobili. Here the parallelism of the two phenomena is so exact that on following textually the memoir of the Italian *savant* it will be found that my hydrodynamic rings imitate the electro-chemical rings in all their details, mode of development and of propagation in waves, forms, dimension, even coloration in certain cases—everything is parallel. On the other hand, M. Guébhard has succeeded in establishing experimentally and theoretically that his equipotential figures relating to the efflux of electricity are exactly represented by the differential equation of the curves of level given by Lamé.

$$\frac{d^2\phi}{dx^2} + \frac{d^2\phi}{dy^2} = 0.$$

As on my part I have proved that the hydrodynamic rings are analogous to those of Nobili, and as M. Guébhard has shown the identity of form of the two kinds of curves, it results necessarily from this double verification that the electro-chemical rings of Nobili may be represented by the general formula—

$$\Delta^2\phi = 0,$$

which consequently relates at once to the equipotential curves of hydraulic and electric flux.

Were there merely this single instance it would suffice to prove the reality of the analogy between the two orders of phenomena in question—*i.e.*, the assimilation of the electric flux to a liquid flux.

It appears to me scientifically and logically impossible that analogies so striking, so numerous, extending to so many different regions of electricity holding good even in the most minute details, and often approaching identity, should be merely deceitful appearances. I hold that these attractions, these repulsions, these energetic vibrations which I have obtained, these hydraulic figures so exactly analogous to magnetic figures, these rings so distinctly developed in waves like those of Nobili, have something as real as the *physical points* or *centres of force*, as the *atoms covered with forces*, as the *transformations of the potential energy of ethereal matter associated to ponderable matter*, an *energy of transfer* or of *motion of the totality of the ether*, and as that subtle distinction between *matter* and *substance*; abstractions upon which the *conception* of M. Ledieu depends, and which naturally recall that excellent rule of Newton, "the great, the principal, affair which we must keep in view in Physics is to reason upon phenomena without the aid of imaginary hypotheses."—*Comptes Rendus*.

On an Experiment of Amperes.—By R. Felici.—If, in the experiment of Ampères, in which three circles of the radii, 1, 2, and 4, traversed by the current of the second, being movable, are placed side by side in the same plane, then circles are set so as to be all three perpendicular to the right line connecting their centres, it may be easily calculated that an equilibrium exists when z_1 and z_2 represent the distances of the circles from each other, s, s_1 and s_2, the radii, if

$$z_1 : z_2 = s : s_1 = s : s_2$$

provided that the elements of the current act upon each other according to the law of the inverse square of the distance. To demonstrate this principle, Felici has constructed a simple apparatus, in which the middle circle of aluminium wire is suspended with its plane in the vertical plane, like the middle movable horizontal circle of the ordinary apparatus, between two connaxial rings of wire whose radii are respectively the half and the double of the intermediate ring, and can be moved upon a slide. The whole apparatus is covered with a glass shade.—*Wiedemann's Beiblätter*.

NEW COMPANY REGISTERED.

Kelway's Electric Log Syndicate (Limited).—Capital £6,500, in £10 shares. Registered office, 58, Lombard Street. Objects: To acquire the letters patent granted to C. E. Kelway and C. E. Kelway in conjunction with Frank Dyer, relating to ships' logs. Signatories (with one share each): F. R. Dyer, Yiewsley, Middlesex; A. Cooper Abbs, 6, Fenchurch Buildings; C. E. Kelway (electrician), 6, Fenchurch Buildings; W. T. Wilson, Ifield, Crawley, Sussex; H. O. Cooke, 8, King's Road, Peckham; H. J. Godebye, 67, Southampton Street, Camberwell; W. J. Graham, 14, Bedford Row. Registered 2nd inst., by Messrs. Wilson, Morriss and Co., 58, Lombard Street.

NEW PATENTS—1883.

1113. "Electric generators." R. D. BOWMAN, J. E. L. CLARK, and W. J. K. CLARK. Dated March 1.

1115. "Telephonic apparatus." A. R. BENNETT. Dated March 1.

1120. "Telephonic apparatus." W. R. LAKE. (Communicated by E. Holmes and E. T. Greenfield). Dated March 1. (*Complete.*)

1121. "Obtaining materials and elements to be used in constructing and working primary voltaic batteries." D. G. FITZGERALD and T. J. JONES. Dated March 1.

1122. "Secondary batteries or accumulators." D. G. FITZGERALD. Dated March 1.

1127. "Method for insulating wires for electrical purposes." W. A. PHILLIPS. Dated March 2.

1135. "Electrical accumulators or secondary batteries." W. R. LAKE. (Communicated by N. S. Keith.) Dated March 2. (*Complete.*)

1139. "Apparatus for indicating, controlling, and regulating the flow of electric currents for lighting or other purposes." P. R. ALLEN. Dated March 2.

1156. "Electric incandescence lamps." A. M. CLARK. (Communicated by J. M. A. Gérard-Lescuyer.) Dated March 3.

1175. "Electric lamps or lighting apparatus." H. H. LAKE. (Communicated by E. Weston.) Dated March 5.

1182. "Electric lamps." J. E. L. and W. J. K. CLARK and R. D. BOWMAN. Dated March 5.

1184. "Apparatus for regulating the speed of engines used for driving dynamo machines for electric lighting and other purposes." P. W. WILLANS. Dated March 5.

1190. "Secondary or storage batteries." T. ROWAN. Dated March 6.

1192. "Underground conduits for electric wires." A. J. BOULT. (Communicated by W. Plankinton.) Dated March 6. (*Complete.*)

1197. "Secondary piles, or batteries, or accumulators of electricity." E. G. BREWER. (Communicated by E. Pfiefer.) Dated March 6.

1198. "Dynamo-electric machines." C. LEVER. Dated March 6.

1202. "Electric lamps." E. and A. E. JONES. Dated March 6.

1208. "Galvanic batteries, and means for storing electrical energy." T. SLATER. Dated March 6.

1218. "Improvements in electro-magnetic signal apparatus for railways, and in the means to actuate the same." W. MORGAN-BROWN. (Communicated by J. D. Gould, B. M. Plumb, and G. W. Daniels.) Dated March 7. (*Complete.*)

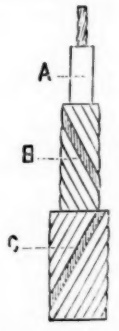
1238. "Telephonic apparatus." S. P. THOMPSON. Dated March 7.

1240. "Electrical induction apparatus." E. EDWARDS. (Communicated by G. Babillot.) Dated March 7.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

3129. "Machines for generating electricity." T. VARLEY and H. B. GREENWOOD. Dated July 3. 2d. Relates to electric generators, and consists in the novel construction and arrangement of the field-magnets and of the parts which operate in connection or combination therewith, for generating the electric currents. (*Provisional only.*)

3142. "Manufacture of submarine telegraph cables." G. E. VAUGHAN. (Communicated from abroad by S. Trott and F. A. Hamilton, both of Canada.) Dated July 4. 6d. This invention relates to the manufacture of an improved form of submarine telegraph cable, and has for its object the prevention of any twisting or wringing asunder of the cable whilst being submerged, or during the process of heaving



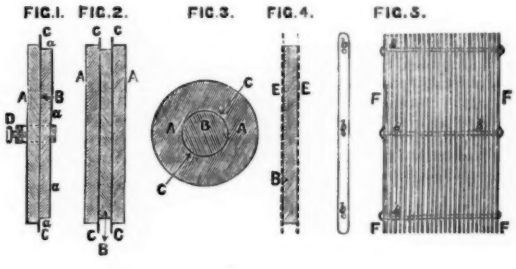
in for the purpose of repair or recovery. The figure shows the invention. A portion of the yarns, say the right-hand, are laid spirally around an insulated conductor, A, in the manner shown at B, that is to say, the right-hand yarns are laid on so as to form a left-hand layer or serving. The next layer or serving is composed of left-hand yarns laid on right-handed as shown at C. This alternation of layers of right-hand and left-hand yarns effectually prevents any twisting or wringing asunder of the material, and may be continued until the desired strength be attained.

3160. "Regulating the currents in dynamo-electric machines." W. R. LAKE. (Communicated from abroad by J. Carpentier, of Paris.) Dated July 4. 4d. If the dynamo machine is revolved at an invariable speed, and the inducing current traverses without interruption the fixed electro-magnets, the magnetic field being itself invariable, the electromotive force of induction will be constant. If, however, by any suitable means a series of periodical interruptions is effected in the passage of the inducing current, it will be readily understood that by reason of the inertia even of the magnetisation and demagnetisation of the masses of iron constituting the fixed electro-magnets, the discontinuous current will act as a continuous current whose intensity will bear with the continuous inducing current the proportion $\frac{1}{t}$, t being the effective time during which the current passes in a second. It is simply necessary that the interruptions and re-establishments of the currents should succeed each other so quickly that the masses of iron have not time during the alterations to sensibly change from a magnetic condition. This condition is always realisable. The present invention relates to such a method of graduation of an inducing current by periodical interruptions. (*Provisional only.*)

3161. "Incandescent lamps." A. R. LEASK. Dated July 4. 2d. The improved lamp may be described as all neck and no bulb, so that a group of them can be fixed upon a stand or candelabra close together in a way that the ordinary lamps would not permit of. (*Provisional only.*)

3171. "Apparatus for governing marine engines by electricity." W. W. GIRDWOOD. Dated July 5. 6d. Has for its object the governing of marine engines by electricity. According to the invention a tube or tubes are placed at any convenient part of the ship, preferably close to the propeller, in order that the sea may have free access to a float placed within the tube or tubes aforesaid. This float is connected to suitable apparatus for making and breaking electric contact between the terminals of the leads or an electro-magnet or solenoid. The armature of this electro-magnet is in connection with the throttle valve of the engines to be controlled, either directly or indirectly, by the aid of an auxiliary steam cylinder —the armature in this case being connected to the small slide thereof.

3172. "Voltaic batteries." J. IMRAY. (A communication from abroad by P. Jablochkoff, of Paris.) Dated July 5. 6d. In voltaic batteries it is usual to employ as negative element a metal such as zinc, which requires the presence of acid to produce the voltaic action. According to this invention a more readily oxidisable metal, such as sodium or potassium, is employed, so that the voltaic action is produced by the presence of air alone, preferably somewhat moist, as this is sufficient to cause oxydation. Along with the oxidisable metal there is employed an inert conductor, such as carbon, or spongy platinum, or metal gauze, the porosity of which is necessary to admit air to act on the oxidisable metal, and some porous material such as thin paper is interposed between the two elements. The cell consisting of the two elements may be arranged in many different ways. For example, the elements may be in the form of flat plates clamped together with paper between them, or the carbon may be in the form of a hollow cylinder with a rod of the sodium or other oxidisable metal inserted in it. As the action should take place only on the surface exposed towards the inert conductor, it is preferred to protect the exposed edges of the oxidisable plate by varnish or other suitable coating. The battery may be rendered and kept inactive by immersing it in oil or other liquid which does not give off oxygen, or by placing it in a vessel charged with hydrogen, or combustible or other gas devoid of oxygen. When it has been served with oil it can be rendered active by washing out the oil with spirit or other solvent, and its activity can be increased by moistening the surrounding air or by covering it with moistened fabric. The battery may be employed as a secondary battery, that is to say, after it has operated for a time as a primary battery, during which a portion of the negative element becomes oxidised, this oxide may be reduced to the metallic state by an inverse current of electricity passed through the battery, and thereupon the battery can again act as a primary battery. By the use as described above of a metal so oxidisable as sodium, great electrical power can be obtained from a compact and light battery,



and notwithstanding the high price of the metal, its oxidation proceeds so slowly when it is subject only to the action of the air, that upon the whole the cost of electrical production by its use is less than that resulting from the use of many other metals. A battery, according to this invention, may have any required number of cells, and each of these may be of various forms. Fig. 1 is a section of a simple cell consisting of a plate, A, of carbon to which is secured by a clamp D, the plate, B, of sodium, with a sheet of paper, C, interposed between the plates. The exposed surfaces, *a a*, of the sodium are varnished. Fig. 2 shows the sodium plate, B, between two carbon plates, A A, with interposed paper, C. In the arrangement shown in fig. 3 the

sodium, B, wrapped with paper or fabric, C, is inserted as a core in a hollow cylinder, A, of carbon. Fig. 4 shows the sodium plate, B, between two sheets, E E, of metallic gauze or fabric or perforated metal. These may be in the form of gratings as shown in fig. 5, consisting of bars, F, held together by ties, *b*. As the sodium becomes oxidised producing caustic soda, this takes moisture from the atmosphere which promotes the oxidation, and the soda solution finds its way through the pores or perforations. A large portion of the soda in presence of the nitrogen of the atmosphere in the pores of the carbon becomes converted into nitrate of soda. For better starting the battery it is first dipped in a liquid, preferably alcohol, and then on withdrawing it its action begins. It is also of advantage to dip in nitric acid the carbons that are to be used in the battery. Sufficient moisture for the action may be obtained by immersing the ends of the interposed sheets of paper or fabric in water, which soaks them by capillary action. The carbons are preferably grooved or furrowed, or made up of a number of rods placed together. When there is not sufficient moisture, sometimes there is formed on the sodium a crust consisting of soda and its carbonate which introduces considerable internal resistance. This may be prevented by covering the surface of the sodium with a thin layer of amalgam by applying to it oxide of mercury, which becomes partly reduced by the presence of the sodium, producing metallic mercury that amalgamates with the sodium and soda which is removed. Or otherwise the mould in which the sodium is cast is coated internally with amalgam which adheres to the metal cast in the mould. Another way of preventing formation of crust on the sodium is to melt with it a metal or metalloid which can be oxidised by the air producing oxide in gaseous form. Phosphorous answers well for this purpose and its presence with the sodium adds to the power of the battery.

3173. "Apparatus for recording speech." J. IMRAY. (A communication from abroad by A. Gentilli, of Leipsic, and L. C. Alexander, of Boulogne.) Dated July 5. 2d. This invention relates to apparatus whereby articulate speech is recorded in symbols that can be readily interpreted. The apparatus consists of two parts which may be at a distance from each other, the one part, which may be termed the "sender," being applied to the mouth of the speaker, and the other part, which may be termed the "recorder," being applied to a moving paper or other surface on which the record is made. The "sender" consists of a light frame held by a handle projecting down from it, and having mounted on its upper surface five light spring levers, which extend up to and into the mouth of the speaker, with their ends resting against various parts of the lips, tongue, and palate, while the frame is steadied by two hooks on its under side catching within the front teeth. By the movement of the organs of speech in articulating various sounds, some or other of these levers are caused to move, and their movements are communicated to the "recorder" either mechanically by threads guided over pulleys, or electrically by making and breaking contact with wires leading to electro-magnets. In the "recorder" a strip of paper or other receptive surface is caused to travel by clockwork, or, when electrical communication is employed, by a ratchet and anchor worked by an electro-magnet, and pens, styles or markers applied to the travelling surface, and moving in obedience to the movements of the levers of the "sender" mark on the surface sets of lines and curves which can be interpreted so as to reproduce the articulate sounds that acted on these levers. (*Provisional only.*)

3175. "Electric insulating apparatus." W. F. BOTTOMLEY, J. H. BAREY, and J. J. LUNDY. Dated July 5. 4d. Has for its object to provide more perfect insulation, combined with the better preservation of the apparatus employed therefor at a considerably less cost than has hitherto been practicable. Such invention consists in the preparation and application of materials not hitherto used for such purposes and hereafter more fully referred to. In order to carry out the invention the inventors proceed as follows:—They dissolve leather with dilute muriatic acid, chloride or sesquichloride of iron, either made purposely or as a bye product of other manufactures, or with caustic soda or other solvents, which solvents or any excess of them may be expressed therefrom or neutralised therein or first neutralised therein and then expressed therefrom as most desirable. Or they employ osseine obtained by treating bone with dilute muriatic acid after extracting the phosphates. Or they employ other gelatines or glues produced by any of the well-known methods from bones, hoofs, horns, or other untanned substances.

3176. "Manufacture of insulating compounds, &c." M. MACKAY. Dated July 5. 4d. This invention relates to the manufacture of improved compounds or compositions for electric insulation, also applicable for forming moulds for electro deposition for electro-plating and for copying wood-cuts in copper by the electro process, also for copying set up type, engravings and the like. In manufacturing the improved composition, the inventor combines by heat in a suitable vessel mineral wax or paraffin wax, wood tar, shellac and asbestos or other suitable dry fibrous substance, in or about the following proportions, *videlicet*, about one part by weight of wax, twenty-four parts of wood tar, and thirty-two parts each of shellac and asbestos or other suitable dry fibrous substance. The above proportions are those which are found to answer well for a soft compound, suitable for such uses as those for which gutta-percha has generally been employed.

3181. "Dynamo-electric machines." A. LEVY. (Communicated from abroad by D. Lachaussée, of Belgium.) Dated July 5. 2d. This invention consists in such an arrangement of electro-magnets that all the points of the magnets are utilised, and form as many consequent points. These magnets are placed around a ring formed of bobbins, which are all connected in tension, and the extremities of which abut on a commutator. (*Provisional only.*)

3190. "Electric and other tell-tales." A. SCHWEITZER and T. LAWRIE. Dated July 6. 8d. This invention is designed as an effectual check on clerks, workmen, watchmen and others, and also on barmen and others taking money in small amounts, thus preventing irregularities and fraud. The first part of this invention is for an electric self-printing tell-tale for recording by automatically printing in plain figures without ink or chemicals, on plain paper, the exact time of visits to certain places, of night watchmen in lunatic asylums, watchmen of works, timekeepers of factories, policemen, firemen, prison warders and others. For this purpose the inventors employ an instrument containing a pair of rollers, one of which has the numbers 1 to 12 fixed or engraved upon the periphery, the plain paper from a roll and a piece of carbonic linen, paper, or other transfering material, are continually being wound together between the rollers by a train of clockwork, so that the figures on the periphery of the rollers print the hours of the day or night upon the paper. When connection is made at any one of the appointed places by the watchmen or others, the current acting upon an electro-magnet draws down a lever at the end of which is a letter or figure. The paper then shows in plain figures, letters or other symbols the exact time and place of each visit, and if any spaces are left without such marks it shows at a glance which places have been visited or not at any particular time.

3204. "Apparatus for the generation, regulation, and utilisation of electric currents." W. R. LAKE. (Communicated from abroad by Elihu Thomson, of America.) Dated July 6. 1s. 4d. Relates to electric generators, motors, regulators, and lighting apparatus or mechanism, and comprises various improvements. This patent is too lengthy for abstraction.

3217. "Machinery for applying anti-induction coverings to insulated electrical conducting wires." G. S. PAGE. (Communicated from abroad by J. M. Stearns, jun., of America). Dated July 7. 2d. In the specification to Imray's patent, No. 5468, of December 14, 1881 (being a communication from the said J. M. Stearns) was described a method of preventing induction in a group of telegraph or telephone conductors by providing a covering consisting of a thin sheet metal band, bent backwards and forwards so as to form longitudinal corrugations or loops, within each of which one of the insulated conductors was introduced. The present invention relates to machinery or apparatus for bending the said sheet metal band into the corrugated or looped form, for introducing the insulated conducting wires into the several corrugations or loops, and for compressing the combined covering and conducting wires into a cable. (*Provisional only.*)

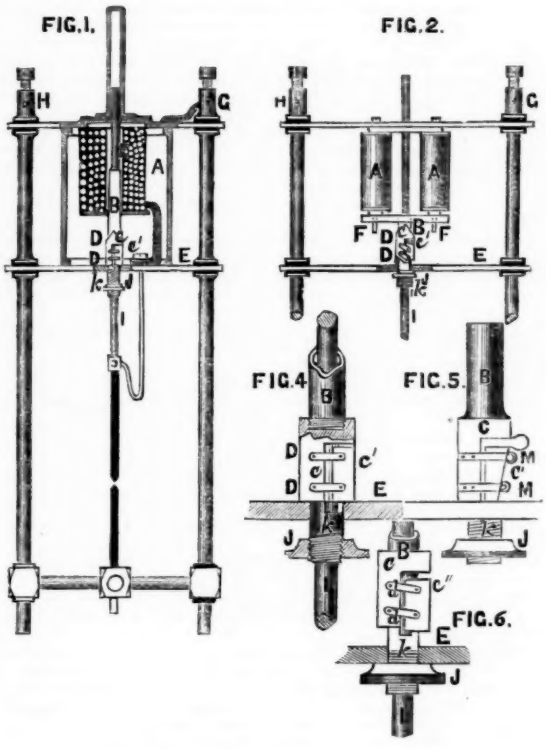
3219. "Supports for underground electrical conductors and their conduits." G. S. PAGE. (Communicated from abroad by J. M. Stearns, jun., of America.) Dated July 7. 2d. According to the present invention there is provided within the conduit for electric conductors or cables a support, consisting, according to one arrangement, of a continuous trough-shaped receptacle, within which the conductor or cable is placed, so as to have its metallic sheathing or covering in electrical connection with the metal of the support, which, in its turn, is in electrical connection with the conduit, and consequently with the earth, by means of a stem or foot on its under side fitting into or cast in one with the bottom of the conduit. The support may either be rectangular or cylindrical in shape, and it may either be quite open at top or be provided with overhanging flanges or lips. (*Provisional only.*)

3221. "Secondary batteries." R. H. WOODLEY and H. F. JOEL. Dated July 7. 2d. Relates to improvements in the construction, charging, and regulation of electrical batteries known as secondary batteries, or accumulators, and are as follows:—The first improvement is in the formation of the electrodes, and for this purpose the inventors employ "lead wool" compressed to any suitable extent, and in any suitable form. The second improvement is in the construction of the partitions between the electrodes of asbestos in porous or perforated sheets, or other convenient form. This improvement provides a partition of great indestructibility and resistance to acids. The third improvement is in the employment of bichromate of potash in combination with the "lead wool" as electrodes. The fourth improvement relates to the charging of secondary batteries; the inventors first charge in the usual manner batteries of large surface, and from these again charge batteries of smaller surface to effect the service. By this method of charging it is proposed to effect economy of time. The fifth improvement relates to the regulation of the quantity of the charge in the batteries, and this is effected by means of an automatic switch, actuated by a differential circuit or by a discharge from a condenser, brought into operation at any fixed standard of quantity, and switching the charging current to a new set of cells. (*Provisional only.*)

3226. "Electro-magnetic motor." E. TOYNBEE. Dated July 7. 6d. This motor consists of a series of concentric, parallel, revolving and stationary electro-magnets, so arranged that the whole shall form one or more continuous rings of magnetic poles, enclosing the whole (or nearly so) of the magnetic lines of force, both as regards the stationary and revolving magnets. These rings may be multiplied to any extent on the same axle or spindle, the whole of the revolving (or stationary magnets) being commutated at each segment of the circle into whatever number of segments the circle may be divided, thus producing a maximum and uniformly continuous rotatory motion, from whatever source the electricity may be derived (whether from the voltaic battery, or dynamo, &c., &c.), utilising the whole of the available forces both of attraction and repulsion, the force being so distributed as to act directly as a rotatory power without lateral strains, and without the use of any intervening gear, thus doing away with all unnecessary friction, consequently with all waste of power, obtaining an effect equivalent to from eighty to ninety per cent. of the theoretical amount of power to be obtained from a given amount of electricity. With this machine great velocities are obtained, with no heating effects and a minimum of wear and tear, the only friction being that necessary to be overcome in revolving the absolute weight of the load itself.

3233. "Electric clocks." J. P. A. SCHLAEFLI. Dated July 7. 6d. Relates to an improved secondary electric clock to be actuated by a weight raised periodically by a current sent at frequent intervals from a central station.

3236. "Arc electric lamps." F. M. ROGERS. Dated July 7. Consists, in an improved method, of regulating, or controlling arc electric lamps. Figs. 1 and fig. 2 show in part section and elevation the improved method of regulating that class of arc electric lamp, in which the arc is maintained by the gradual descent of the upper carbon. A, fig. 1 and fig. 2, is the solenoid, or the electro-magnets,



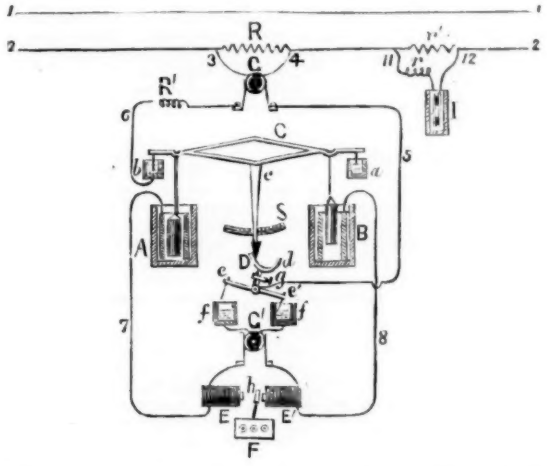
wound preferably with thick insulated wire of say 12, or 14 wire gauge. B is the wrought or cast-iron core, or if electro-magnets are used as in fig. 2, the armature. Attached to either the core, or armature, in any convenient manner, or cast or forged in one piece with it, and extending downwards towards the base or floor of the lamp, and when necessary passing through it, is a clipping arrangement, C, consisting of a block or rectangular piece of metal, divided or separated lengthwise, at its centre line, to one side or diagonally. This block, which is made in halves, is clamped together, and in order that it may when bored exactly fit the rod, a thin slip of metal such as brass, or iron, is placed between the halves, and then after clamping or sweating the halves together, the block and core are carefully bored out to the exact size of the rod intended to be used. After boring the rectangular block is filed or shaped up square on the faces parallel to each other, and the core and nose piece of which half of it may form part, or to which the rectangular piece is fitted, is carefully turned and made to slide easily within the hole, F, in the solenoid, fig. 1; or if an armature and electro-magnet be used as in fig. 2, the armature is drilled, and made to slide upon the two pins, F, F, which act as guides. Two or four or more links, D, D, are now made and fitted by means of screws to each side of the two halves of the block. After they are placed in their proper position parallel to each other, the screws are removed, and the thin piece of metal taken out, the half block is then re-united as before, and so fastened as to be quite free to move up and down parallel with its counterpart, which is attached to or forms part of the core, and nose piece; figs. 4 and 6 show this clip full size and will make its construction quite clear. Upon a current entering the lamp at G, the opposite terminal, H, being connected up so as to complete the circuit with the machine, the solenoid or electro-magnet is excited sucking up the core, or attracting the armature, B, the loose half of the block, C^1, dropping by gravity to the position shown in fig. 6, the rod, I, is tightly embraced and lifted up, thereby separating the carbons and establishing the arc. As the carbons burn away, the resistance to the current entering at G, and flowing round the solenoid or electro-magnet, increases, and the core in the case of the solenoid gradually drops, until the loose half of the block, C^1, which when gripping the rod hangs lower than the part to which it is attached, touches the plate or floor, E, the rod is then released and slides slowly through the block, shortening the arc, and as more current then flows round the solenoid or electro-magnet, its length is adjusted. The movements described are effected so rapidly as to be almost imperceptible, and as the rod is held rigidly and the release takes place gradually the half block acting as a species of brake, the blinking and jumping, peculiar to arc lamps regulated by a ring or washer, is avoided, while the rod is always smoothed and unscored. The nose-piece, K, which in figs. 1, 2, 5, 6, is shown as part of the core, extending through the plate, is screwed to receive the nut, J, and the travel of the core or armature can be regulated to strike the arc of any desired length.

3240. "Plates for electric accumulators." T. S. SARNEY and J. M. ALPROVIDGE. Dated July 8. 4d. Relates to the manufacture and formation of plates which are suitable for use in electric accumulators or secondary batteries. The invention consists in making said plates of thin laminated metallic sheets in or with which are intimately commingled, amalgamated, or impregnated lead or other suitable metallic oxides, peroxides, or sulphates, or other suitable substances.

3244. "Incandescing electric lamps." T. J. HANDFORD. (Communicated from abroad by C. A. Van Cleve, of America.) Dated July 8. 2d. In incandescing electric lamps, wherein a carbon filament is enclosed in a hermetically sealed exhausted glass globe or chamber, it has been found that there is still more or less aqueous vapour contained within the lamp after the globe has been exhausted and sealed from connection with the pump. This vapour is not wholly removed by the drying agent used in connection with the pump during the process of exhaustion, but remains within the lamp and has a deleterious effect upon the carbon filament. The object therefore of this invention is to remove this vapour from active relation with the carbon filament; and this is accomplished by sealing within, or in connection with the interior of the lamp globe, a compound capable of absorbing aqueous vapour such as phosphorus anhydride, which is prefered for the purpose. (*Void by reason of the patentee having neglected to file a specification in pursuance of the conditions of the letters patent.*)

3255. "Incandescent electric-lamps, &c." J. H. GARDINER. Dated July 8. 6d. Has for its object improvements in the construction of incandescent electric lamps and in apparatus therefor, which apparatus is also applicable for other like uses."

3271. "Electrical meters." T. J. HANDFORD. (A communication from abroad by T. A. Edison.) Dated July 10. 6d. The said invention has for its object producing an automatically registering meter for measuring the electrical energy consumed in a circuit, which shall be simple in construction and efficient in operation. This is accomplished by the use of two electrolytic cells, two of the electrodes (one of each cell) being suspended from the ends of a beam which is supported or suspended so as to oscillate or turn upon its centre. The accompanying figure shows an elevation partly



diagrammatic of the meter. A and B are two electrolytic cells, each composed preferably of two cylindrical electrodes of amalgamated zinc placed in a solution of sulphate of zinc. One electrode of each cell is suspended from the end of a beam, C, which is pivoted or suspended to turn centrally. At one end this beam is connected with the reciprocating plunger of a dash pot, *a*, while at its other end it has a rod projecting into a mercury cup, *b*, and kept constantly immersed in the mercury of the cup. The beam, C, has an arm or finger, *c*, projecting therefrom, which plays in the U shaped yoke, *d*, of a pivoted circuit controller, D, the parts being insulated to prevent short-circuiting the cells. This circuit controller has three arms—a vertical arm which has the yoke, *d*, at its end and two horizontal arms, *e* e^1, provided with points dipping in mercury cups, *f* f^1. The circuit controller is pivoted at the junction of the three arms, and its vertical arm has an adjustable weight, *g*, to throw the circuit controller when it is carried over the centre by the arm, *c*, of the beam, C. E E^1 are two electro-magnets acting upon an intermediate armature lever, *h*, the movement of which works the register, F. G G^1 are simple hand operated current reversers, which are shown separated for clearness of illustration, but which in practice are mounted on a common spindle and moved simultaneously. 1, 2 are the main conductors of a house circuit, having placed therein a resistance, R, around which is the shunt circuit through the meter. This shunt has wires, 3, 4, running from opposite sides of the resistance to the current reverser, G; from one spring of the current reverser a wire, 5, extends to the circuit controller, D; from the other spring of the current reverser a wire, 6, extends to the mercury cup, *b*; and from the stationary electrodes of the cells, A B, wires 7, 8 extend to the coils of the electro-magnets, E E^1, and thence to the current reverser, G^1, and the mercury cups, *f* f^1. A resistance, R^1, is placed in the shunt circuit at any particular

point common to both cells to compensate for variations in the resistance of the cell in circuit caused by changes in the temperature of the solution. The apparatus operates in the following manner: assuming the reversers to be in the position shown in the fig. and the beam, C, depressed at cell, A, and elevated at B, then the arm, e^1, of the circuit controller, D, will be depressed, making contact with the mercury in cup, f^1, while arm, e, will be elevated, breaking contact with mercury in f as shown. The current in the shunt will then be from 2 on one side of R by wire 4, through G by wire 5, through D, cup, f^1, reverser, G^1, electro-magnet, E^1, wire 8 from stationary to suspended electrode of cell B, beam C, cup b, wire 6, resistance R^1, reverser G, and wire 3 to 2 on the other side of the resistance R. E^1 will attract h as shown, causing it to work the register with one impulse, and there will be a deposit upon the elevated suspended electrode of B until its weight overcomes the weight of the depressed suspended electrode of A, when the beam, C, will be tipped, the movement being regulated by dash-pot, a, and the electrical connection with C being maintained by the mercury cup, b. Now the point of e will be in the mercury of cup, f, while the point of e^1 will be raised out of the mercury of cup f^1. The current will now flow from 2 by 4 G, 5, D f, G^1, electro-magnet, E, 7, from stationary to suspended electrode of cell, A, C, b, 6, R^1 G, 3 back to 2. The electro-magnet, E, will now attract h, giving another movement to the register, while the deposit will be upon the elevated suspended electrode of A, which will finally overbalance the depressed suspended electrode of B, causing the beam, C, to tip again and repeating the operation. In this operation the suspended electrodes act as the cathodes of the cells, and the meter works by depositing metal first upon one electrode and then upon the other. At the end of a month or after any other lapse of time the reversers, G G^1, will be turned. The stationary electrodes will then become the cathodes of the cells, and metal will be stripped from each suspended electrode when in a depressed position until it becomes lighter than the elevated electrode, when the beam will be tipped.

3281. "Electrical conductors." F. JACOB. Dated July 11. 6d. Letters-patent, dated January 17, 1882, No. 231, have been granted to C. W. Siemens for an invention communicated to him from abroad by F. Jacob. According to the title and provisional specification of the said letters-patent the invention is confined to "Improvements in telephonic conductors," and although the invention is also applicable to electrical conductors other than those used for telephonic purposes, it may be doubtful whether under the said title and provisional specification it could be properly claimed for other than telephonic conductors. As the inventor desires to claim the invention as applied to electrical conductors generally, whether they are used for telephones, telegraphs, electric lights, electric power machines, or other apparatus to or in which electricity is applied, he now, during the period of provisional protection granted for the invention described in the said provisional specification, and before publication or use of the said invention, desires to obtain farther letters-patent for the invention in its extended form.

3795. "Electric lamps." W. R. LAKE. (A communication from abroad by J. B. Wallace, of America.) Dated August 9. 6d. Relates to improvements in electric lamps or lighting apparatus the chief objects being to construct a protector or shade for the light which shall completely enclose the carbons and prevent circulation of air around the points of the same; and to arrange the entire mechanism of the lamp in a common holder below the shade, whereby the carbons and all the mechanism may be easily removed without disturbing or removing the globe or protector. It also has for its object the support and adjustment of the carbon or carbons. The said invention comprises a protector composed of a lower section of spherical shape open at its bottom and top, and an upper section closed at its upper end, and arranged to be set upon, and close the upper opening of the lower section, and so that the upper or adjustable carbon may extend through the lower section, and up unto the upper section, and be readily removed therefrom without disturbing either section of the protector; it also comprises various improvements in the details of construction.

3882. "Telephonic apparatus." F. R. WELLES. (A communication from C. E. Scribner and W. R. Patterson, both of America.) Dated August 15. 6d. This invention has for its object improvements in telephonic apparatus; and relates in the first place to that system of inter-communication known as the telephone exchange or central office system.

4073. "Electric bell and automatic alarm apparatus, &c." P. M. JUSTICE. (Communicated from abroad by V. Vankeerberghen, of Brussels.) Dated August 25. 6d. Upon a piece or plate of wood, metal, or other suitable material, the inventor affixes by means of an ordinary terminal and its binding-screw, a piece of copper bent at right angles to its flange, upon which is horizontally secured a plate composed of metals of different expansive powers. The free end of said plate is provided with an insulated button, and also with a hole, hook, or catch, to which a cord may be attached so that the apparatus may be worked directly by the hand or may be placed above the door or in any convenient position and there worked by a cord or wire. Upon the first-mentioned plate is secured the second terminal provided with an adjusting screw by which the amount of motion necessary to ring the ordinary electric bell may be regulated. The adjusting screw is held in position by means of a second screw of similar construction. It will be noted that the apparatus serves not only as an ordinary electric call bell but also as an automatic alarm, as in case of excessive heat the plate, composed of metals of different expansive powers, will so expand as to touch the lower point of contact, and, by completing the circuit, cause an ordinary alarm bell to ring.

4930. "Electric arc lamp." C. S. SNELL. Dated October 17. 6d. Relates to an improved form of arc lamp.

CITY NOTES, REPORTS, MEETINGS, &c.

Mediterranean Extension Telegraph Company (Limited).

THE fifty-first ordinary general meeting of this company was held at the City Terminus Hotel, Cannon Street, on Friday, the 2nd inst., Sir James Carmichael, Bart., the chairman, presiding.

The Secretary, Mr. E. Tombs, read the notice convening the meeting, and the report of the directors, which appeared in our last issue, was taken as read.

The Chairman said: In moving the adoption of the report and accounts I have just to call your attention to what is stated in the report, namely, that there is a slight falling off in the traffic receipts of this half-year, which is, as you will easily understand, attributable to the interruption for nearly three months to the Corfu-Otranto cable. The expenses connected with the cable have all been paid, but they have absorbed so much of the Government guarantee—in fact all we have received—that we are left with only enough balance to pay 1½ per cent. dividend on the ordinary stock, and the usual dividend of 8 per cent. on the preference stock. You will understand that the Government guarantee instead of for six months was only for five months. It ceased on 1st December last. I do not know that there is anything to call your attention to particularly in the accounts. I think they are identical with those of the former half-year. The directors are making every effort to cut down the expenditure, and during the ensuing year we may be able to save £100 in the working of the London office, but I do not see much chance of a further reduction. The expenses at Malta and Corfu are already as low as they well can be to carry on the business efficiently. I shall be happy to answer any questions connected with the report or accounts.

Mr. Attrell, shareholder, seconded the motion.

A Shareholder: Supposing this resolution is passed will there be an opportunity afterwards given of discussing the position of the company?

The Chairman: Certainly.

A Shareholder: Do I understand the expenses of the repairs of the cable were taken out of the Government guarantee fund?

The Chairman: Out of the general receipts, including the Government guarantee.

The Shareholder: This guarantee has now ceased?

The Chairman: Yes!

The Shareholder: And therefore the company is left to its own resources?

The Chairman: Yes!

In answer to a shareholder who asked why the reserve fund was not appropriated,

The Chairman said the reserve fund was the backbone of the company. They had it to fall back upon in the case of necessity. In the event of anything happening to their present cable where would they be without the reserve fund (hear, hear)? He looked upon it as the most important item of the company's property.

A Shareholder: It is the safeguard of the company.

The resolution was unanimously adopted.

The Chairman next moved the payment of the usual dividend of 8 per cent. on the preference-stock and a dividend of 1½ per cent. on the ordinary stock, free of income-tax. The accounts, he said, had been submitted to the Treasury and approved. They could not yet appoint a day for the payment of the dividends as they had not yet received the money, but as soon as they did notice would be given to the shareholders.

The Hon. Ashley Ponsonby seconded.

This resolution was likewise unanimously carried.

The Chairman here intimated that this finished the business of the day, but that the directors would be happy to hear what any shareholder had to say.

Mr. Burt desired to say a word with reference to what took place at the last meeting. He was not able to be present, but he observed from the report of the proceedings that there was obviously some misunderstanding with regard to the letter he had written respecting the purchase of the company's undertaking. He was there as an ordinary shareholder—a very small shareholder—of some years' standing, and it appeared to him their position was such that the ordinary shareholders ought carefully to consider it. At the last meeting, in reference to the reserve fund, it was remarked that it was not the business of the Eastern Telegraph Company what the shareholders should do with it. He desired to discharge himself of any considered impertinence in the matter. He was asked to divide the purchase money offered of £40,000 between the preferred and deferred shareholders. He said he thought it was not his business to do that—it was a matter for the shareholders—but he was told on authority that he must do so, and accordingly he did it, and it appeared to him it was only a suggestion that something should be said to call the shareholders' attention to the fact that there was a reserve fund to divide amongst them. He saw from the report that the directors had solicited proxies from the shareholders, asking their opinions as to whether the offer of the Eastern Company should be accepted or not, and that although there were 83 in favour of the purchase and 18 against it, the directors did not act on the former, but he supposed voted against the proposal, and consequently it was rejected. The position of the company was now this: the Government guarantee had ceased, and the shareholders, therefore, could only look to the revenue of the company for a dividend in the future. For several years past, he might safely say, there never had been a net revenue from the earnings of the company exceeding £1,500, and that was not enough to pay a dividend on the preference shares. Unless some extraordinary event arose by which the profits of the company were doubled it was clear that the ordinary shareholder could never see a dividend again, and it seemed to him that point was hardly brought out for consideration at their last meeting.

He called attention to it in the hope that the matter would now be considered on its merits. He had no desire to press the sale in any particular way, but he wished to call the shareholders' attention to their position. So far as he could judge, they would never after that meeting receive a dividend upon their shares in that company. The present 1½ per cent. on the ordinary stock was paid distinctly out of the Government guarantee of £3,000. The report said, "The claim due from the Treasury for the five months ended the 2nd December, when the Government guarantee expired, is £3,000. This sum will suffice to pay the usual dividend on the preference stock, and also a dividend of 1½ per cent. on the ordinary stock." The preference shareholders, his impression was, were under a misapprehension as to their position. It was scarcely to be expected in the circumstances that the company could long exist if it was to go on paying them that dividend of 8 per cent., and he should object to it. And let them look at the expenses incurred in carrying on that miserable little affair: Directors' fees and officers' salaries, £441; rent of offices in London, &c., £57 7s. (he was not complaining of those being excessive); at Malta, salary of superintendent, wages, &c., £496 13s. 4d.; rent of offices, fuel, and light, £69 1s. 6d.; and at Corfu, salary of manager and wages, £222 17s.; and rent of offices, fuel, and light, £57 14s. 1d., the total amount altogether being £1,663 12s. 2d. On the other side, the total receipts for messages were shown to be £2,307 10s. 11d. The report said the earnings of the company were rather less than in the corresponding half of the year 1881, which might be accounted for chiefly by the temporary interruption of the Corfu-Otranto cable, but he could not find that there had been any considerable increase in the receipts for the half-year. If the directors could tell the shareholders there was a probability of a large increase there might be something to wait for, but in the meantime the ordinary capital spent on these cables was to produce nothing, and they were to go on year after year, he supposed—he did not know why—until the cables were dead. They were about twenty years old—his impression was that one of them was thirty years old—and they could hardly expect they would require no further repairs. During the last year £2,000 had been spent in repairs on the Corfu cable, and repairs were very frequently required, and he supposed the expenses would have to come out of the revenue or out of the reserve fund. It seemed to him that they were dribbling out and wasting away, and that unless something was done to realise very promptly there would be nothing left in three years for the ordinary shareholders or preference shareholders. The matter ought to be taken into their serious consideraton.

Mr. Hurst said as an ordinary shareholder, he should like to move a resolution that would have the effect of opening negotiations with the Eastern Telegraph Company. The resolution was as follows: "That a committee of five shareholders be appointed to consider with the directors the expediency of negotiating for the sale of the company's property, and to report to a special meeting on the subject as early as possible." He did not see the slightest possibility of his ever receiving anything from the company, and he was therefore in favour of the property being sold.

Mr. Ladd seconded.

The Chairman: I will answer Mr. Burt. There is only one question of his I need answer. As regards the negotiations with the Eastern Telegraph Company they were fully discussed at a meeting a short time since, and the whole subject placed before the shareholders in the most open manner. Mr. Burt's letter was sent to the shareholders, and not a word of it altered. The directors most carefully abstained from influencing the shareholders in any way whatever. Anybody who was present at that meeting will remember that I said that we did not wish in any way to influence the shareholders in their voting, but we were pressed and asked which way we would vote ourselves, and only then did I say that as a shareholder I would sooner take my chance of holding the property than selling my shares, and that as a director I was there to carry out the wishes of the shareholders. Of course we can go over the ground again if the shareholders wish it, but the proposition to sell was at the last meeting unanimously rejected. As regards the proxies, I do not think we were called on to use them when the meeting was against the adoption of the proposal. A great many proxies were sent to the directors to use as we pleased, which we declined doing. That was one reason why we did not use the proxies. Another reason was that the bulk of those in favour of the proposal being accepted were not legally signed, or, at any rate, doubtfully; they had not been witnessed.

The Hon. Ashley Ponsonby: The articles require a witness to the signature.

A Shareholder: The proxies were sent out by the board.

The Chairman: The forms were perfectly correct, but many of them were returned irregularly signed—they were not signed in presence of a witness.

A Shareholder: If the offer had been made in money it would have been wise to accept it; but when there was such a small amount te be paid to the ordinary shareholders it seemed absurd to offer a mere preference.

The Chairman: That was the opinion of the meeting which, as I said before, the directors did not influence in any way. If it is the wish of the present meeting to make any other offer to the Eastern Telegraph Company we shall be happy to make it in your behalf.

A Shareholder: I propose if the Eastern Telegraph Company offers the same amount in cash it be received.

The Chairman: There is another resolution before the meeting.

A Shareholder: If we further negotiate with the Eastern Company it is probable it may do more.

The Chairman: Mr. Burt, who is present, will give us his opinion as to whether or not it is likely to do anything more. He wrote to me that he was of opinion it would not.

A Shareholder: I should like to hear if the chairman can explain away the prognosticated future financial position of the company. Is there any prospect whatever of this company's operations realising a dividend for the ordinary shareholders, or indeed being able to pay a dividend on the preference shares? I venture to say there is not. Any man who understands the working of telegraph companies knows that something must be done.

The Chairman: Something must be done I quite admit.

A Shareholder: The reserve fund is being gradually wasted away.

A Shareholder said he had been connected with as many companies as most gentlemen. He had seen a good deal of committees, and in nine cases out of ten they had been appointed with no good result, so he did hope they should have no committee appointed to assist the directors. In a little affair like that, if the shareholders had not confidence in the directors to look after their affairs the sooner they sent them about their business the better. In a little concern like that—he called it a little concern—to ask for a committee of shareholders to assist the directors to negotiate with a large company like the Eastern was absurd. The Eastern Company would laugh at them, and very rightly too. If they wished negotiations to go on let their directors carry them on, but do not let the Eastern Company see that there was dissension amongst them. Once it saw that, it would say, "Now is the time to make our market and do what we like."

A Shareholder: Do you suppose they do not read the reports?

The Chairman: They may read the reports.

A Shareholder said he would vote against the motion. It would be impolitic, he thought, to appoint a committee. Let their directors go to the Eastern Company and say if it will give them a 5 per cent. debenture and not 4—£50,000 if they liked to name the sum total—and all under £100 stock in cash, they would accept the offer. He thought that would meet the little shareholders; it would save them a great deal of bookkeeping, and they would be able to carry on the business of this little affair without much trouble. He hoped his suggestion would meet the views of the chairman.

A Shareholder said the directors had throughout stated that they did not wish to take upon themselves the responsibility. That being the case, it was surely no dissension for a body of shareholders to come forward and say, "With the directors we should like to negotiate with the Eastern Company to see what terms it will come to with us." Surely, as men of business, they must move in the matter now. If their cable broke they must infringe on their reserve fund. He would ask the chairman to put the resolution to the meeting.

Mr. Robinson asked if there was not a little inconvenience in passing a resolution of that kind at such a meeting? If it was intended to begin new negotiations, should the shareholders not be informed of the fact, and have an opportunity of expressing their opinion on the matter?

Mr. Burt: This meeting is for transacting the general business of the company.

Mr. Campbell: The resolution, as Mr. Burt knows, would be inoperative; but if the majority of the shareholders present were of opinion that negotiations should be begun again by the directors, I have not the slightest doubt the directors will follow their directions, but a resolution, appointing a committee, passed at a meeting of this kind, is inoperative.

Mr. Burt: I think this is a matter competent for the meeting to deal with if it thinks fit. I should like to say I have been somewhat troubled of late about proxies. I find nothing in the articles of association requiring a witness to a proxy. From the report of the proceedings of the last meeting I find that the directors, having invited the shareholders to say what they desired, received 83 answers in favour of the purchase, and only 18 against it, and notwithstanding that——

The Chairman: A large number left their votes in the hands of the directors.

Mr. Burt: The figures being 83 to 18, I should have thought the duty of the directors should have been to have acted according to the wishes of the 83, and not of the 18.

The Hon. Ashley Ponsonby: I should like you to see them.

Mr. Campbell: There were several questionable; but it appeared on the face of a good many of them they were quite illegal. I will not undertake just now to say what it was, but there was not a question in my mind as to their illegality. We will have the proxies looked at and tell you.

Mr. Burt: I simply take the report which says 83 shareholders——

A Shareholder: Are you two lawyers discussing legal matters (laughter)? I think you are quite out of order if you are.

Mr. Burt: The report says 83 shareholders have sent in proxies in favour of the purchase, and 18 against. My opinion is the 83 shareholders' views were not attended to, and that the views of the 18 were. I think the directors on the last occasion refused to express any opinion as a board of directors on the proposal to purchase. I am surprised that the directors did not suggest or advise, and if they did not—I assume they had very good reasons for not doing it—surely it is the duty of somebody outside the board to consider the question independently of the board, or with the board. The directors are a small body, and two of them are directors of a competing company—the Eastern Telegraph Company. That may be the reason why they should not go either against——

A Director: Wrong.

The Chairman: I am not a director of a competing company.

A Shareholder: Is it the fact that two of the directors are directors of the Eastern Company?

The Hon. Ashley Ponsonby: No.

Mr. Burt (continuing): That is a reason why the directors should hesitate in advising the shareholders.

The Hon. Ashley Ponsonby: I hold 170 shares in the company. I did not think your offer a good one, and that is the reason I did not wish to accept it. I think we might negotiate again. I should be very happy to get an offer I should like.

A Shareholder: Can you give a better one?

Mr. Robinson said the meeting, it appeared to him, had taken a wrong view of the position of the company. The great object the

board had had was to ascertain what would be accepted. There was no use beating about the bush and asking £3 when the former value was only about £2, and it was useless to try to approach the Eastern Company with such a demand. A year and a half ago they were offered £2 10s. for their shares. They rejected the offer with contempt. They said, "No, unless we get £3 we won't take it." What were the directors to do? The Eastern Company said, "We won't give you £3. If you are not inclined to take something reasonable, it is no use our negotiating with you." It was for the shareholders to express an opinion as to what their property was worth; without such an opinion the board could not act. The board must have some data to go upon. They knew that Mr. Ford was well versed in telegraph companies. He was connected with the Eastern Company and also with the West India and Panama Company, and why did he not do something for the company?

A Shareholder: This is a most irregular proceeding.

Mr. Robinson (continuing) said the shareholders had only to give the directors some data on which to go upon, and the directors would endeavour to carry out their wishes as far as they could, and if the directors could not get what the shareholders wanted they would bring forward what they could get.

Mr. Hurst: I would have been pleased to have had £3 for my shares some time ago, and I would be pleased if any gentleman would give me £2 10s for them to-day. I should be glad to get that price.

A Shareholder: What is the price in the market?

Mr. Hurst: The price in the market is £1½ to £2.

Mr. Ford: Mr. Robinson has addressed me somewhat personally, and has asked me why I did not do something for the company? If the shareholders will place me in a position to endeavour to do something—to open negotiations with the Eastern Telegraph Company—I will not have the slightest hesitation in accepting the responsibility, but until I am invited to take that responsibility, I shall not place myself in the invidious position of representing gentlemen who have not authorised me to negotiate. That is the only answer I have to make to the very unnecessary personal reference to myself.

A Shareholder: There is apparently great anxiety in this room on the part of some one representing the Eastern Telegraph Company.

A Shareholder: I have no interest whatever in the Eastern Telegraph Company.

The Chairman: Before I put this resolution I must state that I think you will place the board in rather a false position by carrying it. At the last meeting you decided on something totally different, and I do not know of anything that has occurred to-day to alter your opinions.

A Shareholder: Will you kindly read the resolution?

The Chairman read the resolution as above.

The Shareholder: It does not say anything about the Eastern Company.

The Chairman: No, but there is no other company to negotiate with as far as I am aware.

The Shareholder: Mr. Adams suggested you should negotiate with some other company.

The Chairman: There is no other company except the Eastern Company that we can deal with.

Mr. Adams could not help thinking that by continually going back to this Eastern Company they would be doing an immense piece of mischief (hear, hear). In doing so he thought they were adopting the worst policy in the world. The property must be sold or not sold. It was a bad concern, but they could get a good price for a bad concern if they did not keep pressing on one company to buy it. The shareholders absolutely refused to take the money offered by the Eastern Company. If the Eastern Company was willing to give the same amount now the directors could not prevent them accepting it; but by no means let them appoint a committee; let the matter be placed in the hands of the directors. For his part, he would keep out of the way of the Eastern Company and try some other company. It must be left to the shareholders to decide as they pleased. He thought there were many companies that might be disposed to take up that little matter as a nucleus.

Mr. Ford: Would you give us a name?

Mr. Adams: Would Mr. Ford be kind enough to wait till he had finished? He would not weary him much longer, because he knew he did not like to hear what he had been saying. Let the shareholders say what price they would take, and let the directors go and see if they could not get the price determined on.

In answer to a Shareholder,

The Hon. Ashley Ponsonby said he did not think the offer which had been made was one that as a shareholder he would like. He would not give his opinion as a director for the very reason he had before stated. He should prefer to trust to the chapter of events. He had given that opinion under compulsion.

The Chairman: I prefer to tell the shareholders that, individually, I could not undertake to act as a member of a committee to renew these negotiations. As a member of the board I should be happy to carry out any of your instructions, but I could not put myself in the position of having shareholders to go with us to back us up.

A Shareholder: It is not proposed you should go. There is no proposal of the kind.

The Chairman: It is a proposal to go to somebody.

The resolution was then put to the meeting and rejected by 7 to 5.

The Chairman: That concludes the business.

Mr. Ford here demanded a poll, and the articles of association on the subject having been read to him, he obtained the necessary number of shareholders' signatures (five), and it was agreed that the poll should take place that day between the hours of 2 in the afternoon and 6 in the evening.

A desultory discussion followed.

Mr. Ford wished the directors and the shareholders to thoroughly understand each other, and asked if any number of shareholders present thought proper to approach the Eastern Company, or any other company, and obtained an offer that the board would call a special meeting to consider that offer.

The Chairman: Certainly.

Mr. Adams: That is perfectly fair.

Mr. Robinson: The board have always been desirous of amalgamation. If Mr. Ford is connected with the Eastern Company, and will bring forward some offer the board will be only too happy to entertain it, and, therefore, with such views, a committee would really be frustrating the object we have in view.

The meeting then adjourned till Monday when, it was announced, the result of the poll would be declared.

At the adjourned meeting held at the City Terminus Hotel on Monday Sir James Carmichael again presided.

Mr. Campbell intimated the result of the poll as follows:—For the resolution 7 persons voted, holding 708 shares, representing 105 votes; against the resolution 13 persons voted in person, representing 534 shares, representing 77 votes; the proxies in the hands of the directors number 9, representing 1,160 shares, representing 190 votes, making 267 votes against and 105 for the resolution.

The Chairman: Well, now, gentlemen, I believe the resolution is lost.

Mr. Burt: Do the directors claim to act on the votes by proxy?

The Chairman: Certainly.

Mr. Burt: And which were not referred to at the former meeting. The shareholders who gave proxies knew nothing about it.

The Chairman: No poll was demanded at the former meeting.

Mr. Burt: If you had intimated that the directors held proxies I do not think my friends would have pressed you to take a poll. That is my impression on the subject. I am sorry you did not inform the meeting of that. You might have saved some trouble and some expense. It appears from the figures read by Mr. Campbell that the shareholders voting in person, with a knowledge of the facts, is considerably in excess of those voting against.

Mr. Campbell: A small excess—four votes.

Mr. Ford: From what Mr. Burt says, practically the resolution has been carried, because it has been carried by the votes of the shareholders present, but has been defeated by the votes of proxies held by the directors, and not stated at the time to be held by them and intended to be used by them.

Mr. Campbell: That shows what an irregularity it was to allow the resolution to be put at all, considering the majority of the shareholders were absent and knew nothing about it.

Mr. Burt: That irregularity must rest on the solicitor of the company.

The Chairman: The solicitor of the company pointed out the irregularity, but in deference to the wishes of a minority of the shareholders present, the resolution was put by me, and I wish to take the responsibility of that upon myself. I overruled Mr. Campbell's advice.

Mr. Burt: You exercised your proxies on an illegal resolution.

The Chairman: That may be so. There is no harm done.

Mr. Burt: I beg to move a vote of thanks to the chairman. However we may disagree with him in politics or principles you all agree with me that he is a very excellent chairman (hear, hear).

Mr. Adams: I am sure I shall be very happy to second that. I was afraid you were getting into a passion at being defeated.

Mr. Burt: The monopoly of passion rests with our friend, Mr. Adams.

The motion was unanimously carried, and the chairman having returned thanks, the meeting separated.

[In reporting this meeting our representative was utterly unable to obtain the names of all the speakers. Our readers will coincide with us—speaking of companies meetings generally—that this is attributable to the chairman, who fails to announce the names of the speakers as they rise.—EDS. ELEC. REV.]

The Western and Brazilian Telegraph Company (Limited).—An extraordinary general meeting of this company will be held at Saint Michael's Hall, George Yard, Lombard Street, E.C., on Thursday for the following purposes:—(1.) To declare a dividend of £3 per cent. on the (reduced) capital of the company (in accordance with the recommendation contained in the annual report dated 3rd January, 1883, adopted by the shareholders in general meeting on 11th January, 1883) for the year ending 30th September, 1882, the necessary resolutions for the reduction of capital having been duly passed and confirmed by the shareholders, and sanctioned by the court on the 16th day of February, 1883; and (2.) To submit certain resolutions in accordance with a requisition signed by shareholders holding over 11,000 shares, and duly lodged at the company's office, as required by the Articles of Association of the company.

The Great Western Electric Light and Power Company (Limited).—A special meeting of this company was held at the Cannon Street Hotel on Tuesday, Mr. H. Russell Evans in the chair. Special resolutions were submitted and unanimously adopted, authorising the directors to take the necessary steps to make the shares with £2 10s. paid fully paid-up shares.

The National Telephone Company (Limited).—At a meeting of the directors held on the 1st inst. it was resolved to pay 6 per cent. preference dividend for the six months ending 31st December last, less income-tax.